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THE IMPORTANCE OF SCIENCE IN THE CLASSROOM
AND IMPLICATIONS FOR TEACHING
SCIENCE EFFECTIVELY

by

Jaime Elizabeth Hallez

A Research Project Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Education

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ABSTRACT

Science Weather Unit

Past research has shown that the U.S. is in need for a reform of the science curricula. This project was designed to demonstrate an exemplar science unit that contains all the elements needed for students to learn science effectively and build their scientific literacy. Theories have been applied such as Piaget's Theory of Developmental Processes and Gardner's Theory of Multiple Intelligences to tackle ways to increase scientific literacy of elementary students. In addition, scientific inquiry and inquiry process skills are referenced in great detail to provide teachers who lack scientific background knowledge, some ideas of what makes science lessons effective for students. Overall, this Science Weather Unit provides many examples for teachers on what an effective science lesson looks like in the classroom.

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Chapter 1

INTRODUCTION

Science is embedded into everyday life, and in order to participate as a citizen of the United States, one needs to be knowledgeable about a variety of science issues (Leshner & Perkins-Bough, 2007). A general understanding of science should be a priority in science education. Since science is a part of everyday life that surrounds one's day to day activities, it should be a main concern in the school curriculum; however, overall, the funding for science is steadily decreasing, even though students in classrooms today hold the key to the future of the U.S. scientific community. For this reason, it is important to encourage students to become involved in science through a variety of practices to encourage their interest. In addition, it is important to correct any misconceptions that students have about science and scientists so that these preconceived notions do not hinder their learning experiences. Unlike other subjects that one can learn from reading a textbook, science needs to be a hands-on experience in order for students to benefit. This is how students learn science successfully; however, in order for students to learn, they must have effective teachers. Overall, learning science is important in the classroom, and it should be considered a priority and included in the daily curriculum.

Statement of the Problem

According to Nelson and Landel (2007), overall, past research has demonstrated that, in the U.S., there is a need for a reform of the science curricula in schools today, and science learning must become a priority in order to see an increase in student performance. In order for these changes to be effective, there must be a focus on science education at the elementary level. In fact, students who begin middle and high school with insufficient knowledge in science are unlikely to reach grade level performances without intervention. Perhaps the most crucial part in the establishment of an effective science curriculum is the effectiveness of the teacher. While many teachers have the necessary supplies to integrate science into their classrooms, some of them lack the professional development and qualifications to teach science effectively. Ferguson and Ladd (1996, as cited in Nelson & Landel) reported that it has been found that students, who have effective teachers for at least 3 years in a row, are considered high achieving regardless of their: (a) family income, (b) race, (c) ethnicity, or (d) parents' income. According to Weiss and colleagues (2003, as cited in Nelson & Landel), there is a severe shortage of effective science teachers in the U.S. Weiss and colleagues conducted a study of effective teachers and found that only 18% of the 364 teachers they observed across the U.S. possessed the essential elements of effective science instruction. This lack of effective teaching instruction could stem from a variety of reasons. First of all, there are few teachers who have science degrees. In addition, some teachers might be intimidated about teaching science and, usually, are left on their own to develop interactive science topics

and lesson plans. Lastly, learning science may have been an uninteresting subject area for the teacher when he or she attended school and, thus, may have a bias about what teaching science is all about. Therefore, there is a need for a change in the perceptions of teachers in schools today in regard to teaching science curricula. Also, appropriate knowledge and background of science and effective ways to teach it must be provided to teachers.

Purpose of the Project

Science education is extremely important and this knowledge contributes to the development of a well rounded individual. Science is a part of everyday life and, thus, it is vital for students to have sufficient background knowledge. The purpose of this project will be to develop a science unit on weather to demonstrate an example of effective instruction to teachers. Teachers will have a concrete reference, which will allow them to see how the elements of effective teaching are incorporated into an interactive series of lessons, so that they will be able to apply it to their own classroom activities.

Chapter Summary

In summary, science education is fundamental in the development of a well rounded human being. Many teachers, today, lack the ability and knowledge to teach science in an effective way. Thus, the purpose of this project will be to provide a science unit plan on whether to demonstrate the elements of effective instruction for teachers to reference and apply to their own teaching methods.

In Chapter 2, a review of literature will be presented to provide the background of: (a) U.S. science education, (b) current theories in science

education, and (c) best practices for teaching science in the classroom. In Chapter 3, this author will detail the target audience, the procedures that will be utilized, and the goals for the completion of the weather unit. Also, a peer assessment will be provided to provide feedback on the project as a whole.

Chapter 2

REVIEW OF LITERATURE

The purpose of this project will be to develop a science unit for teachers to use as a guideline for the implementation of science in the classroom. The science unit will be focused on weather, and there will be several examples to demonstrate the best practices for teaching science in an effective way. Overall, in the United States, more often than not, there is less emphasis on science curriculum in schools today. In addition to unclear expectations for teaching science in many U.S. schools, there is a severe lack of teachers who have sufficient background in science and do not have the necessary knowledge to teach science effectively.

A Brief History and Background of Science Education

During Colonial times at the beginning of the 19th Century, learning how to read and write was the main focus of education (DeBoer, 1991). The ability to read and write was what separated the educated from the uneducated. Moreover, education was obtained by members of the higher social classes and was thought of as less essential for the rest of the population. However, toward the end of the 19th Century, the views on education began to change. Not only was education focused on reading and writing, but it became evident that a broader education was necessary, due to a world that was becoming dominated by science, technology, and industry. In addition, by the end of the 19th Century, education

became a necessity for all people, not just for the members of the upper class society.

The incorporation of science into the current school curriculum posed some challenges at first (DeBoer, 1991). A campaign was started to promote the learning of science in the educational system, in which many well known scientists participated such as John Tyndall, Thomas Huxley, Claude Bernard, Justus Von Liebig, and Joseph Hooker. Science was taught through hands on experiences in order for students to feel empowered and to develop their conclusions independently. This was the main focus of the scientists. In order to demonstrate their vision, this group of scientists gave lectures, wrote essays, and most importantly testified before the government about the importance of science education. Due to their ongoing motivation to change the direction of the current education curriculum, these scientists were successful in creating a revolution with the addition of science into the school curriculum. By the end of the 19th Century, science was incorporated into the school curriculum. Due to the current educational theories, science was taught from a laboratory approach because it was thought that students should have the opportunity to understand general science principles through science inquiry. As science education continued, there was a movement for science education to become more relevant to the lives of the students.

This movement continued for the next 30 years, and science education activists focused on the same ideas they had identified since the beginning of the 20th Century (DeBoer, 1991). Although the ideas about science education

remained the same for the first 20 years of the 20th Century, there was one notable change that altered educational practices. Standardized achievement tests were introduced, and science was taught in a more factual way so that the information could be easily measured. These standardized tests allowed for differentiation among the students and provided a more accurate assessment of the students' performance, so that teachers and counselors could place students in an appropriate science class.

By the 1940s, little had changed in the science curriculum (DeBoer, 1991). However, with the beginning of World War II, the structure of science education was questioned again. After a series of events during the Cold War, there was a major change in science education. The lack of technical personnel due to the Cold War, the launch of Sputnik by the Soviets, and the constant claims by critics in regard to the lack of progressive education in the U.S. led to a dramatic change in science education. Government officials decided to do something about science education and, thus, efforts were made to make it more well rounded, and students were encouraged to think and act like scientists. While the members of the Commission on the Reorganization of Secondary Education (CRSE; 1912, as cited in DeBoer) were able to develop ways to teach science in a logical way, they did not design a set of basic principles to guide the curriculum and instruction.

As a result of the science curriculum developers' failure to detail the important goals on how to successfully teach science, a new movement was soon under way (DeBoer, 1991). Scientific literacy, or "the relationship between science and society, and the integration of science with the rest of human life and

with other academic disciplines” (p. 172) became the new focus that would make the connection between science and society. The idea that science should be relevant to all students, and not just those who were interested in being future scientists, was still a primary topic during the first half of the 20th Century.

Scientific Literacy

Scientific literacy remains a topic of concern in education today (Hodson, 2006). This term has been used to mold the science curriculum, and it has become a main goal in schools across the U.S. The ideas that surround scientific literacy are seen as highly desirable for all students and, usually are implemented beginning in the primary grades. “Since the term scientific literacy first appeared in the US educational literature nearly half a century ago, in papers by Paul Hurd (1958) and Richard McCurdy (1958), there have been numerous attempts to define it” (p. 293). While there is no absolute definition to clearly define the term, scientific literacy, often there are familiar details found within each individual definition.

What Is Scientific Literacy?

As a result of the many explanations of what scientific literacy is, all of the following should be included in the definition as a whole.

1. A general understanding of some of the fundamental ideas, principles, and theories of science
2. Some knowledge of the ways in which scientific knowledge is generated, validated, and disseminated
3. Some ability to interpret data and evaluate their validity and reliability
4. A critical understanding of the aims and goals of science and technology, including their historical roots and the values they embody

5. An appreciation of the interrelationships among science, technology, society, and the environment
6. An interest in science and the capacity to update and acquire new scientific and technological knowledge in the future. (Hodson, 2006, p. 294)

While all of these definitions are open to interpretation, there is still a general idea within each of these statements. Moreover, none of these definitions would be attainable if scientific texts were not available. It is the scientific language of symbols, diagrams, graphs, and equations that are used in the teaching of science, which allow for the shaping of one's own ideas in order to generate scientific understanding of what is being observed. These skills allow individuals to see the relation between what they have learned and compare it to already existing knowledge. Therefore, if it is difficult for students to read and write, they will struggle to understand science texts. On the other hand, students can be taught to interpret science texts accurately through repeated exposure to science literacy.

Why Is Scientific Literacy Important?

There are various arguments in regard to why scientific literacy for all is important and vital to society (Hodson, 2006). Thomas and Durant (1987, as cited in Hodson) argued that, without a scientifically literate society, the public is less likely to understand the need for financial investment in science and will cease to support scientific research. Also, it is argued that, while people do not necessarily feel hostility toward scientists, currently, there is still a considerable decline in public confidence about scientists. Some people may feel uneasy about: (a) crops that are genetically engineered, (b) the fact that scientists have failed to identify a reason for the causes and effects of global warming, and (c) the

use of science to benefit industries and the military. Overall, it is easy to see how scientists may obtain a bad reputation. Shortland (1988, as cited in Hodson) observed that increased confidence in and support for science depends on one main factor, that members of society have a basic knowledge of the work of scientists. In addition to a basic knowledge of what science is, the public needs to value and appreciate what scientists do.

In addition, educated professionals have argued that people, who are scientifically literate, have more employment opportunities and can respond to a change in technology in the workplace with more ease (Hodson, 2006). The need for people with advanced skills, creative thinking, and problem solving skills has become necessary in businesses today. Moreover, usually, these people become easily accustomed to new ideas in regard to a technologically dominated society. These are the type of attributes that business leaders look for today in employees.

According to Hodson (2006), scientific literacy leads to intellectual, aesthetic, and moral benefits for individuals. To begin with, it is believed that scientifically literate individuals will have higher ethical standards that will lead to a more ethical community. Thus, according to Shortland (1988, as cited in Hodson), if scientific literacy is attained, these values would spread into the culture of the community and, eventually, advance human civilization. On the whole, those who are scientifically literate, would not only be considered more skilled and knowledgeable, but wiser in reference to their moral and ethical decisions.

Perhaps one of the most common arguments in support of a scientifically literate society stems from the government, and the economy becomes the validation for the argument (Hodson, 2006). As cited in Hodson, Canadian government officials made the following statement in order to confirm the link between science education and the future of the country.

Our future prosperity will depend on our ability to respond creatively to the opportunities and challenges posed by rapid change in fields such as information technologies, new materials, biotechnologies and telecommunications...To meet the challenges of a technologically driven economy, we must not only upgrade the skills of our work force, we must also foster a lifelong learning culture to encourage the continuous learning needed in an environment of constant change. (p. 297)

To summarize, it is argued that scientific literacy is important to the economy of a nation. Economic growth depends on a steady flow of scientists, technicians, and engineers into society.

Because scientific literacy remains a topic of concern and is not yet clearly defined, it is important to realize that, as the perception of science changes, so will the assumed definition of scientific literacy (Hodson, 2006). However, even though there are many variations of the definition of scientific literacy, the general concept remains the same. As a technologically dependent society, science will continue to dominate everyday life. For this reason, it is vital that all individuals have a universal understanding of the main concepts of science.

Hodson cited Longbottom and Butler (1999) and explained that:

science education provides ideal opportunities to engage in a wide range of careful investigations and problem-solving activities, where mistakes and wishful thinking are readily exposed. Science education can value creativity but not accept personal theories as an endpoint. The ability to adjudicate between knowledge claims in ways independent of human desires is a special feature of science that has allowed it to build up a

public body of reliable knowledge. Science education should convey these aspects of science. (p. 300)

In addition, there are several valid arguments as to why scientific literacy is important for not only the individual, but also for the future success of society as a whole. This is because a strong background in science enables individuals to evaluate scientists accurately when new knowledge is presented. It allows the individual to establish a valid reason to support their opinion.

Theories in Science Education

The learning of science begins with a sense of wonder that is a common characteristic among all human beings (Esler & Esler, 2001). An inherent curiosity is what drives someone to seek an explanation for something that he or she witnessed. There are many theories about science education as well as the best ways to elicit this natural longing for knowledge. Some of the more familiar theories include: (a) Piaget's (1977) theory of developmental processes, (b) the theory behind model building, (c) constructivist theory, (d) behaviorist learning model theory, and (e) the verbal learning model theory. While all of these theories are based on the idea that learning must incorporate one or all of the five senses, they are very different in their approaches.

Piaget's Theory of Developmental Processes

According to Abruscato (2004), Piaget's theory of developmental processes has supported the ideas of cognitive theorists who believe that children learn by stimulation of their mental processes. This means that children learn when they can think and relate what they learn to their own perceptions of the world. In regard to teaching from a cognitive perspective, a teacher should

attempt to understand what a child thinks before he or she is engaged in any activities. One of the most important cognitive theorists, Piaget's goal was to understand how children make sense of the world, and he made an effort to understand where and how knowledge originates during childhood (Harmon & Jones, 2005). In addition to the realization that cognitive development is dependent upon the development of the brain, Piaget conceptualized the following ideas, which are involved in the process of learning.

1. Children are motivated to learn.
2. Children develop knowledge through repeated experiences.
3. Children learn through assimilation and accommodation, or experience an event and then adjust to it in regard to what they have already experienced.
4. Children must interact with their physical and social environments in order for cognitive development to occur.
5. Children must be in a state of equilibrium before they move on to a state of disequilibrium which eventually moves the child into a new state of understanding.

Piaget's theory is based on four different stages of learning (Esler & Esler, 2001).

These four stages are: (a) the sensorimotor stage, (b) preoperational stage, (c) concrete operations stage, and (d) formal operations stage.

Sensorimotor Stage

In the sensorimotor stage, or the period immediately following birth to about 18 months, the child uses all of his or her senses to begin to make sense of

the world (Lind, 2005). Touch, taste, sight, hearing, and smell are the sensory abilities that the child begins to use. In addition to use of their senses, also, they begin to develop their motor skills; at first, they crawl and then eventually learn to walk. During this period, the child begins to recognize shapes and sizes in relation to his or her surrounding environment (Esler & Esler, 2001). Lastly, during this stage, a sense of self is developed, and the child begins to have an idea of who he or she is.

Preoperational Stage

The preoperational stage occurs between the ages of 2-7, during which the child begins to think more abstractly (Harmon & Jones, 2005). During this period, the child is able to discuss objects that are out of his or her perceptual view (Abruscato, 2004). The child understands that, even though an object is not there, it does not mean that it does not exist. On the other hand, children at this stage are easily deceived by what they already know about the world (Esler & Esler, 2001). For example, if the same amount of water is poured into a short fat glass vs. a tall skinny glass, the child will think there is more water in the tall skinny glass because this is what is perceived to be true. Moreover, language during these years tends to advance at a rapid rate, and speech becomes the child's main avenue for expression (Lind, 2005). Children are able to differentiate objects with the use of simple terms such as big and small, light and heavy, square and round, late and early, long and short, and many other variations of simple expressions.

Concrete Operational Stage

The next stage of Piaget's (2005) as cited in Harmon & Jones, 2005) developmental processes' is the concrete operational stage, which occurs between the ages of 7-11. In this stage, children are able to think in a more logical way. Unlike the preoperational stage, children in this stage can classify objects in regard to their similarities and differences in a concrete and literal way (Esler & Esler, 2001). Moreover, in order to categorize objects, usually, the child will go through a process of trial and error before he or she can accurately measure the object. While a child in this stage is able to classify objects accurately, it may still be difficult to pinpoint the variables of a situation and the relationship between those variables and their counterparts (Abruscato, 2004).

Formal Operational Stage

The formal operational stage, or Piaget's (1977, as cited in Abruscato, 2004) final stage, lasts from about 12 years old through adulthood. Thinking during this stage becomes less concrete, and one is able to think in more abstract terms. For this reason, people in this stage are able to solve compound verbal and mathematical skills where numbers are represented by symbols. Also, during this stage, children are able to use the scientific method as a means to solve logical problems (Lind, 2005). Use of the scientific method stems from the ability to see problems from an abstract angle; thus, youth can imagine a solution before they find it.

Implications of Piaget's Theory in the Classroom

First of all, it is important to know that Piaget's (1977, as cited in Esler & Esler, 2001) theories of the developmental processes are well known in many countries. Psychologists from around the world have simulated Piaget's research, only to discover a commonality among various nationalities and cultures. This includes the notion that all children follow the same basic path of development, regardless of culture and natural ability. However, the exact age from which a child moves from one stage to the next tends to vary.

Therefore, it is imperative to understand that students in the classroom will not always be at the same developmental level (Esler & Esler, 2001). This is especially important when it comes to the use of a manipulative in the classroom. For all children, the use of a manipulative will be helpful; however, for some children, who are in an earlier stage of the developmental process, the use of a manipulative is imperative to their being able to learn the material.

Overall, participation in science education enhances the intellectual development of children as they move from one stage to the next (Esler & Esler, 2001). This is because the use of science experiments allows the child to manipulate concrete objects and think outside the box. Physical objects are extremely important to the developmental processes of a child when he or she transitions from one stage to the next. In the application of Piaget's (1977) theories in the classroom, Harmon and Jones (2005) stated that teachers should:

- (a) Use concrete and personalized examples when discussing abstract concepts with students,
- (b) Preassess students' prior level of knowledge and often reassess it later to determine growth in students,
- (c) Provide students with hands-on experiences and opportunities to

interact with their environment in problem-solving activities, and (d) Encourage students to test hypotheses in systematic ways. (pp. 59-60)

Gardner's Theory of Multiple Intelligences

Perhaps one of the most important aspects to consider when teaching is to realize that every child has a unique learning style, or a preferred method to receive information (Lind, 2005). While there are several variations of learning style theories, a well recognized one is Gardner's (1983) theory of multiple intelligences. A fairly recent theory, Gardner identified seven intelligences in 1983. Later, he added an additional intelligence which he termed naturalistic. Gardner believes that these intelligences describe the different ways in which an individual obtains knowledge (Harmon & Jones, 2005). The eight intelligences are: (a) verbal linguistic, (b) logical mathematics, (c) spatial, (d) bodily kinesthetic, (e) musical, (f) interpersonal, (g) intrapersonal, and (h) naturalist.

Gardner's Eight Intelligences

People who use the first intelligence, known as verbal linguistic, prefer to receive information in the form of words (Lewis, 2004). This can be either through reading or verbal aspects of learning. These types of learners prefer to have knowledge given to them and explained aloud. This particular intelligence is dominant in most Western educational systems (Kolb, 1984). Qualities of the verbal linguistic learner include: "(a) understanding order & meaning of words, (b) convincing someone of a course of action, (c) explaining, teaching, and learning, (d) humor, and (e) memory and recall" (p. 3).

The next intelligence, logical mathematics, refers to people who prefer to use logic, numbers, and patterns to solve problems (Harmon & Jones, 2005).

These types of learners learn best when they experiment and test hypotheses (Lewis, 2004). According to Kolb (1984), logical mathematics learners are scientific thinkers who display the following qualities: “(a) abstract pattern recognition, (b) inductive reasoning, (c) deductive reasoning, (d) discerning relationships & connections, (e) performing complex calculations, and (f) scientific reasoning” (p. 3).

Spatial intelligence is third in Gardner’s (1983) list, and these types of people like to work with colors and pictures while they learn (Lewis, 2004). This group of learners pays attention to details and likes to put things together and take them apart visually (Harmon & Jones, 2005). Skilled at visualizations, people who are spatial learners are able to create images and pictures in their mind’s eye (Kolb, 1984). Usually, these people are very imaginative and display the following qualities: “(a) active imagination, (b) form mental images, (c) recognize relationships of objects in space, (d) use graphic representation, and (e) use image manipulations” (p. 3).

Bodily kinesthetic learners, one of the more common types of learners, learn through the use of physical movement (Kolb, 1984). Sometimes, these people prefer to express themselves through bodily movement such as dance. Also, often, bodily kinesthetic learners are very coordinated and tend to participate in various sports and enjoy exercise. These learners learn best when they: (a) move around, (b) touch objects, and (c) interact with the space around them (Lewis, 2004). According to Kolb, the capacities of the bodily kinesthetic learner include: “(a) control of voluntary movements, (b) control of

preprogrammed movements, (c) expanding awareness through the body, (d) a mind body connection, (e) mimetic abilities, and (f) improved body functioning” (p. 2).

Next on Gardner’s (Gardner, 1983) list of intelligences is musical, which refers to one’s ability to learn through a variety of musical forms such as singing or playing an instrument (Harmon & Jones, 2005). People who learn by use of their musical intelligence can replicate melodies and rhythms easily (Lewis, 2004). These types of learners recognize musical patterns with ease and are sensitive to rhythm (Kolb, 1984). These musical patterns or rhythms include the sounds that come from nature or even the human voice. Kolb identified the following capacities of the musical intelligence learner: “(a) appreciation for the structure of music, (b) schemes or frames in the mind for hearing music; (c) sensitivity to sounds; (d) recognition, creation, and reproduction of melody/rhythm; and (e) sensing characteristic qualities of tone” (p. 3).

Interpersonal intelligence, or the sixth on Gardner’s (1983) list, refers to people who like to work in groups and learn best when they collaborate with other people (Lewis, 2004). These types of people prefer to share, compare, and relate their findings with others. Usually, people, who have a greater interpersonal intelligence, are more aware of the feelings and behaviors of others (Harmon & Jones, 2005). Moreover, they are able to distinguish others’ mood and, as a result, can influence others’ thoughts or behaviors. People with interpersonal intelligence thrive on collaborative communication in their relationships (Kolb, 1984). In addition, these types of learners are extremely team oriented. Overall,

interpersonal learners display the following qualities: “(a) effective verbal/non-verbal communication, (b) sensitivity to other’s moods, temperaments, motivations, and feelings, (c) working cooperatively in groups, (d) ability to discern other’s underlying intentions and behavior, (e) passing over into the perspective of another, and (f) creating and maintaining synergy” (p. 2).

Gardner’s (1983) final intelligence, before he identified two more later, is known as intrapersonal intelligence (Lewis, 2004). Rather than being insightful into others’ feelings, these learners are in tune with their own feelings and motivations. These types of people prefer to work alone and like to rely on their own instincts. Most of the time, these people need to think and self-reflect in order to reach a state of spiritual awareness (Kolb, 1984). Intrapersonal learners tend to show the following traits: “(a) concentration of the mind, (b) mindfulness, (c) metacognition, (d) awareness and expression of different feelings, (e) transpersonal sense of the self, and (f) higher-order thinking and reasoning” (p. 2).

Recently, Gardner (1999) added an eighth intelligence known as naturalist intelligence, or one’s ability to understand how nature works (Lewis, 2004). This term, natural intelligence, refers to the capacity to see differences among the varying life forms and become familiar with the patterns that occur in nature (Harmon & Jones, 2005). In science, it is important for students to have some degree of natural intelligence due to the observations and classifications that children in the elementary years are expected to learn (Abruscato, 2004). Moreover, while a ninth intelligence known as existential has been proposed, Gardner (1999) has yet to add it to his list.

Gardner's Multiple Intelligences in the Classroom

While some people may be more accustomed to a particular learning style, Gardner (1983) reported that every individual holds some aspect of each of the multiple intelligences (Abruscato, 2004). Therefore, it is important for teachers to provide opportunities for children to solve problems with the use of their strongest areas of intelligence (Lind, 2005). While it may be impossible to incorporate each of the intelligences into a single lesson, it is important to incorporate more than one learning style. This allows students to experience learning in a way that encourages them to use their natural tendencies; in addition, they can strengthen their weaknesses. Also, it is important to understand that each of the learning styles can be used, regardless of the subject that is being taught. For example, the logical mathematical intelligence is not, and should not be, limited to learning mathematics. Likewise, teaching science should not be the only time that the bodily kinesthetic intelligence is utilized. To summarize, Gardner suggested that students should learn through a variety of multiple intelligences (Harmon & Jones, 2005). Furthermore, there are three things that teachers can do to ensure that most, if not all, of the intelligences are best utilized.

1. Teachers should make sure that new information is taught in a variety of ways such as: (a) introduce a new text, (b) provide a catchy song, and (c) show images of the object or event being taught.
2. In addition to presenting a learning topic in a variety of ways, also, teachers should strive to allow for a range of learning experiences.

This can be accomplished by the use of: (a) small groups; (b) individual work; (c) movement, art, and music for expression.

3. Lastly, different subject areas can be combined to create more memorable learning experiences. Thematic units are a model of this. For example, a unit on weather can incorporate social studies, science, mathematics, and literature. This allows for one subject to be taught across all of the curricula. Also, it is interesting to see how the special teachers may be able to support the overall theme.

Despite the fact that there will always be critics who feel there is a lack of sufficient evidence in regard to Gardner's (1983) theory, it has had a notable impact in the realm of elementary education (Harmon & Jones, 2005). Even though the theory of MI remains a theory, there is much evidence to support the advantages when a variety of learning experiences in the classroom are provided.

Behaviorism

Another approach to learning is the theory of behaviorism in which it is held that anything a child does is directly linked to his or her environment (Abruscato, 2004). The laws of behavior are said to apply to every individual at all ages (Berger, 2005). In addition to this, behaviorists believe that intellectual development occurs at a gradual pace, and there are no specific stages or ages that can determine when this maturation occurs. Moreover, the notion of conditioning is perhaps the most popular aspect of the theory of behaviorism which implies that a response can come only from outside stimuli. Thus, by observation of

changes in the environment, one is able to understand the changes in an individual (Harmon & Jones, 2005).

Implications of Behaviorism in the Classroom

Behaviorists believe that knowledge is constructed through meaningful experiences (Harmon & Jones, 2005). As a teacher, it is important to keep in mind that every individual has had unique experiences that will guide him or her in the path of learning new knowledge based on knowledge that was previously learned. For this reason, it is imperative that teachers present information so that the student can relate to it. One way to do this is to provide connections for students so that they can see how the information is relevant to them. This is done through scaffolding, or building on previously learned knowledge. In addition, along with the students' past experiences, it is critical to have some background knowledge of their culture and possible special education needs. From a behaviorists' perspective, Harmon and Jones provided several key components that teachers can use to help their students learn new material.

1. Stimulate students' prior knowledge before they begin to teach by asking questions or by using an activity.
2. Show students how the information they are learning relates to things they already know
3. Present information in an organized fashion that is familiar to students.
4. Ask students to draw inferences and give opportunities to practice with new information.
5. Provide mnemonics – special memory tricks that help students learn material more effectively – for information that seems random. For example, HOMES represents the five Great Lakes – Huron, Ontario, Michigan, Erie, and Superior.
6. Become more culturally competent (self-aware, knowledgeable, and aware of those different from oneself; exhibit cultural awareness) and culturally sensitive so they

can relate and interact with their diverse students more effectively. (p. 91)

Likewise, it has been suggested that a child who has joyful experiences will develop a positive attitude (Abruscato, 2004). Also, if a child receives praise from his or her teacher or peers, he or she will continue to accomplish their tasks efficiently. In the reinforcement of positive behavior, Abruscato provided examples that a teacher can practice.

1. Praise children when they do a good job
2. Thank the student when they attempt to answer difficult questions
3. Praise improved behavior

Above all, behaviorists strive to look at past experiences as the cause of present behaviors (Berger, 2005). In order to improve the dynamic of the classroom, a teacher can attempt to apply the theories of behaviorism when he or she assesses each individual student. This will allow the teacher to teach more effectively.

Best Practices for Teaching Science in the Elementary Classroom

So far, a general exploration of major theories has been provided that apply to all curricula. However, since the reappearance of Halley's Comet in 1848, the members of the American Association for the Advancement of Science (AAAS; 1985, as cited in Zemelman, Daniels, & Hyde, 2005) began an extensive reorganization of science education in the U.S. Thus, there are additional practices that teachers can apply in their classrooms to increase the success of students, specifically in science education. According to Reed (2005), most students who lose interest in science do so at the middle school level. It is

believed that this is because, during this time, the students begin to use abstract and higher level thinking skills. Perhaps if the best practices for teaching science in the elementary classroom were exercised, the lack of interest in science among middle school students would decline.

Challenges That Educators Face

Many teachers are challenged when they teach science (Abruscato, 2004). Sometimes, students have a negative attitude toward science in regard to the subject and the professions of science. Often, students have stereotypical images of a scientist. In addition, Abruscato reported that some teachers have stereotypical images of scientists which affect their teaching. Many teachers feel that science is too hard for their students to learn and are afraid that they will be unable to answer their questions. However, all children have a natural desire to touch, and they have endless curiosity. In turn, it is the teacher's job to make sure that the science curriculum fits the needs of children's innate craving to learn.

In order to attain scientific literacy for all students, teachers need to be aware of their students' beliefs about science and scientists and strive to make their views more positive (Esler & Esler, 2001). Understanding that some students will have misconceptions about science is the first step toward the development of a positive learning environment. For example, many children view the typical scientist as male (Abruscato, 2004). Usually, this male scientist has unkempt white hair and wears glasses and a white laboratory coat. This common stereotype can discourage many students, particularly girls, from their pursuit of a career in the field of science. As a result of this familiar stereotype,

the teacher must establish a classroom environment in which these views can be challenged. In order to overcome these stereotypes, teachers should identify the contradictions between the children's preconceived notions vs. the new information they are presented (Esler & Esler, 2001). Also, when students work in groups, discussion of their questions can be a helpful learning experience for both the students and the teacher. Finally, once teachers have an understanding of the misconceptions that students hold about science, they should strive to incorporate activities that will allow students to see science in a different light.

Scientific Inquiry

In order to involve students in science, there is a need for a strong motivational interest in what is being taught (Baram-Tsabari, Sethi, Bry, & Yarden 2006). It has been suggested that, when students are curious about an aspect of the world, they may be more likely to use all of their senses to discover answers (Lind, 2005). Once teachers have identified what students find interesting, they can take advantage of this information to build on their natural curiosity to promote scientific inquiry (Zemelman et al., 2005). While there are many definitions for the term, scientific inquiry, Abruscato (2004) stated, "Inquiry is a very careful and systematic method of exploring the unknown so that discoveries are made" (p. 46). Also, Abruscato presented the more detailed definition of scientific inquiry, provided by the National Science Education (NSE; 1989, as cited in Abruscato, 2004).

Scientific Inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which

they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. (p. 46)

It is inherent for young children to inquire about the world around them, which leads to an array of questions and a natural tendency to learn (Zemelman et al., 2005). In the learning of science, learning the main topics is not enough, and students must be immersed in doing science. It is through scientific inquiry or investigations that students can gain an understanding of scientific concepts and theories. There are a variety of activities suggested to teachers by the NSE (1989, as cited in Abruscato, 2004) that demonstrate what a child engaged in the inquiry process looks like. According to Abruscato and the NSE, when students are immersed in the inquiry process they: (a) make connections; (b) pose questions; (c) examine books and other sources of information to determine what is already known; (d) plan investigations; (e) review what is already known based on experimental evidence; (f) use tools to gather, analyze, and interpret data; (g) propose answers, explanations, predictions, and communicate results; (h) identify assumptions, with the use of critical and logical thinking, and (i) consider alternative explanations. Therefore, there are numerous activities that can be linked to the process of scientific inquiry.

While some teachers may believe that the use of hands on experiences sufficient, in order for proper scientific inquiry to occur, the teacher must encourage the students to answer scientific questions based on evidence (Zemelman et al., 2005). If this process is initiated in the lower grades, as the students become older, gradually, they will become more skilled in this area over time. In addition to answering complicated questions, students should be

introduced to scientific inquiry in a variety of ways. Thus, more than one scientific method should be utilized during any given experimentation. There are approximately eight different types of methods that educators have identified in regard to inquiry process skills. These include: (a) observe, (b) compare, (c) classify, (d) measure, (e) communicate, (f) predict, (g) infer, and (h) hypothesize.

Inquiry Process Skills

The first skill, observations, is referred to as the most essential of the scientific thinking processes (Lind, 2005). Without this skill, no one would be able to obtain information about the external world. Observation takes place through the use of the five senses: (a) sight, (b) smell, (c) sound, (d) touch, and (e) taste. People use their senses in order to describe what they observe.

Therefore, as a teacher, it is important to guide students in the use of inquiry process skills so that they can understand that observation is the first step to solve a problem. Questions such as “What do you see?” or “How would you describe this object” might encourage students’ thinking.

The next skill utilized during the inquiry process is to compare or contrast similarities and differences among objects (Lind, 2005). Again, teachers can ask probing questions to encourage students’ thinking about the variances between objects such as “How are these different from one another?” and “How are they alike?” This part of the inquiry process builds upon observation. Similarly, classification, or the next step in the process, builds on comparison.

Classification is a process that scientists use to put objects or events into categories (Abruscato, 2004). These classifications allow scientists to identify:

(a) similarities, (b) differences, and (c) interrelationships. At first, children may be able only to group objects according to one category; however, eventually, they will be able to classify objects in accordance to several categories (Lind, 2005). Teachers can ask questions such as “Can you group them in another way?” and “How are these objects organized?” to guide students through the classification process.

Often, the fourth step of the inquiry process is labeled the measurement process, which is the way in which observations are counted (Abruscato, 2004). In order to measure, one must have a general knowledge of how to use instruments to calculate. When students are taught about measurement, it is important to show them why it is important (Lind, 2005). Questions like “How might you measure this?” or “What object is heavier?” help students to think about different ways that matter can be measured.

Communication is the next step in the process which is crucial in the conduct of scientific work (Abruscato, 2004). When information is dispersed, it is imperative that students are able to: (a) communicate orally; (b) write; and (c) use diagrams, maps, and graphs. For younger students, communication may be presented through the use of pictures or dioramas (Lind, 2005). Teachers can encourage communication if they ask students to record their experiences in a variety of ways.

Prediction is the next step in the inquiry process which refers to a guess about the results of a future observation or event (Abruscato, 2004). Predictions are a part of the later steps in the inquiry process because they are based on: (a)

observations, (b) measurements, and (c) inferences about the relationships of observed variables. During this prediction, or educated guess, students have the opportunity to evaluate their evidence (Lind, 2005). Teachers can help to develop students' prediction skills when they teach them about cause and effect.

Awareness of cause and effect leads to a recognition of patterns that allows students to predict accurately how that pattern will continue. Teachers should permit much practice in this skill which leads to increased accuracy. It is important to guide students through this step of the inquiry process so that they can explain how they developed their prediction.

The seventh step of the process, inference is a way to draw conclusions from what is observed (Abruscato, 2004). In other words, an inference is an explanation of an observation. When children infer, first, they make a series of observations and then categorize them to give them meaning (Lind, 2005). In order for an inference to be made, some background knowledge must be present. It is for this reason that the use of inferences is most appropriate for the middle grades, although children in the primary grades may have opportunities to make inferences on some occasions. Moreover, teachers can ask questions such as "What do you think is inside of these?" or "What did you observe that makes you think that?"

The last step of the inquiry process requires the highest levels of higher order thinking (Lind, 2005). The formation of a hypothesis is considered a formal operation, but it can still be explored in the preschool and primary grades. An example of a question that guides younger students to make a hypothesis might

be, “What happens if the magnet drops?” While it may be the last step in the inquiry process, it is obvious that teachers can utilize these higher order thinking skills with students in all grade levels.

Scientific Classroom Practices

There are several opinions about the best practices for teaching science in the classroom (Ford & Wargo, 2006). In regard to the teaching of science, one of the main goals is to engage students in science from an authentic perspective. Ford and Wargo argued that, in order for new teachers to become successful in teaching science, they must first have an understanding of general classroom practice and the routines, roles, and responsibilities of the teacher and student. Thus, once beginning teachers have a basic understanding of how to manage a classroom, they will be able to conduct science lessons. Ford and Wargo stated that “knowledge of classroom practices interacts with knowledge of science to bring about teaching for authentic disciplinary engagement” (p. 135). Moreover, educational researchers have demonstrated that classroom management thrives when there are shared understandings between the teacher and students about what is expected. This is where the three Rs come into play: (a) routines, (b) roles, and (c) responsibilities. Following the routines, roles, and responsibilities suggested for use in the classroom provides teachers with guidance that allows for effective teaching.

Routines, Roles, and Responsibilities

Routines provide stability which contributes to classroom management (Ford & Wargo, 2006). Moreover, the use of a set routine allows the class to

move forward together so that no one is left far behind. If students know what is expected of them, they will be more likely to finish what they start. For example, a routine during science experiments might be for the students to: (a) work with their groups, (b) present their results, (c) analyze their results with other groups, and (d) then improve their original method.

In reference to roles, there are those of the teacher and those of the student (Lewis, 2004). Clearly defined roles for the teacher and the student result in an understanding, mutual relationship (Ford & Wargo, 2006). For roles, it is important to realize that a teacher can fit into several roles at once (Lewis, 2004). For example, teachers or other adults in the classroom may assume the following categories: (a) team member, (b) teaching assistant, (c) student peer, (d) guest presenter, and (e) volunteer. In regard to a teacher, it is important to include others outside of the classroom such as: (a) parents, (b) siblings, (c) friends, (d) enemies, (e) mentors, (f) tutors, (g) community members, (h) employers, and (i) religious leaders.

Despite the fact that there are several variations of what a teacher can be, the primary role or responsibility of the teacher is to teach. According to Lewis (2004), teaching can be defined as “imparting knowledge, guiding, understanding, and instructing by precept, discourse, example, or experience” (p. 196). It has been said that each person who spends time with a child can be termed a teacher; thus, it is not a question of whether one will teach, but rather what one will teach. In addition to the provision of knowledge, most importantly, it is the role of the teacher to be intentional when he or she intervenes in the learning process.

Also, there are roles and responsibilities of the learner or student (Lewis, 2004). According to Lewis, learning can be defined as “the acquisition of knowledge, understanding, or skill” (p. 197). If it is the responsibility of learners to learn, then it is their responsibility to allow new experiences into their mental, emotional, social, moral, and behavioral aspects of their self. Some educators believe that no learning can take place unless there is a marked change in the learner’s behavior even though some of the changes that take place during a learning experience may not be obviously apparent. All in all, while it is the teachers responsibility to facilitate learning, it is still the students responsibility to make good decisions when he or she participates in learning.

Chapter Summary

The history of science education has changed dramatically throughout the centuries. At first, simply being able to read and write was considered acceptable. Eventually, as technology became more demanding, the views on education began to change. A common goal among educators was to encourage students to act like scientists. Ultimately, this new way of thinking led the notion of scientific literacy for all students, which is still a topic of debate today. In Chapter 3, the methods, target audience, procedures, and goals for the applied project will be detailed.

Chapter 3

METHOD

The purpose of this project will be to develop an elementary science unit for the primary grades, which will be focused on the topic of weather that will consist of all the components necessary for teaching science effectively. Teachers will be able to use this tangible project as a reference to apply when they develop their own science lesson plans. This is important because there are many pieces to the puzzle in the development of an effective science lesson plan. Moreover, because science is a part of everyday life, it is vital that students have adequate knowledge in basic science topics.

Target Audience

This project will be intended for application with students in the lower Grades K-2; however, creative teachers may be able to adapt the project to fit the needs of upper Grades 3-5. Teachers, who would prefer a concrete project to look at for examples, who want to make teaching science in their classroom effective and have little confidence about their teaching of science, will be interested in this project.

Goal and Procedures

The goal of this project will be to provide teachers with a valuable resource to provide the skills needed to make teaching science in the classroom effective. The science unit on weather will demonstrate the key components for

teachers to use when they facilitate scientific literacy. Elements about teaching science will be presented throughout the weather unit for teachers to emulate and put into practice in their own science units and lessons.

Peer Assessment

Several colleagues will be asked to provide informal comments, recommendations, and implications for further research in order to receive a well rounded assessment on the science weather unit. These colleagues will be current teachers in elementary classrooms that this author has observed. Each collaborator will be given a copy of the unit and then asked to review it for ease of application, applicability to the classroom, and whether it is clearly organized. All evaluators will be encouraged to provide further suggestions on the hard copy they are given to improve the existing document.

Chapter Summary

A lack of effective science teachers in schools today continues to be a problem across the U.S. With this science unit, teachers will have a concrete reference to use that will demonstrate what effective science lessons look like. Experienced teachers will be utilized to improve the final project. They will be encouraged to provide a well thought out assessment of the science weather unit.

Chapter 4

PROJECT

Obtaining scientific literacy is important to the future of our students. Because science is a part of our everyday lives, teachers should have knowledge on how to teach science effectively. The following is a science weather unit, which focuses on developing scientific literacy, various theories in education, and best practices for teaching science in the elementary classroom. This unit consists of 14 lessons that cover a variety of weather topics. All of the lessons being presented have been formatted, using the Regis University lesson plan template.

Lesson 1: Temperature

Title:	What is Temperature?		
Content Area: Science		Grade: 1st	Duration: 1 hour
Standards and Benchmarks:	<u>State Standards:</u> Science Standard 1- Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations Science Standard 4- Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space. Science Standard 5- Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.		
Objectives:	<ul style="list-style-type: none">• TSWBAT (the students will be able to) use data based on observations to construct a reasonable explanation• TSWBAT select and use simple devices to gather data related to an investigation• TSWBAT communicate about investigations and explanations• The students will learn how to evaluate a thermometer		
Resources and Materials:	<ul style="list-style-type: none">• 5-7 thermometers• Pencils• 5-7 cups of warm water• 5-7 cups of cold water• Cold Water thermometer sheet (Appendix A)• Warm water thermometer sheet (Appendix A)		

	<ul style="list-style-type: none">• Temperatures in My Classroom! (Appendix A)• Science Weather Unit Progress Check (Appendix A)• <i>Hot and Cold</i> by: Jack Challoner																					
Differentiation:	-Because students will be working in groups of 4-5 students, it is suggested to place students in heterogeneous groups.																					
Preparing Students for the Lesson: <ul style="list-style-type: none">• Transitions• Expected behaviors	Get students thinking about temperature by asking them specific questions to activate their schema or previous knowledge such as: -What can you tell me about temperature? - Why is it important for us to be able to tell the temperature of certain objects? - Who knows what determines the temperature outside?																					
Teaching the Lesson (Lesson Sequence/ Activities): <ul style="list-style-type: none">• Motivation/ Anticipatory Set • Pre-Assessment/ Activating Background Knowledge	<p>To begin the lesson, read <i>Hot and Cold</i>, by Jack Challoner to the students. This book is a nice introduction when referring to hot and cold temperatures.</p> <p>1) Next, make a chart on the board or on chart paper. Label one column hot, and the other column cold.</p> <table><tr><th>HOT</th><th>COLD</th><th></th></tr><tr><td>sun</td><td>ice cream</td><td></td></tr><tr><td>fire</td><td>snow</td><td></td></tr><tr><td>coat</td><td>popsicle</td><td></td></tr><tr><td>stove</td><td>ice</td><td></td></tr><tr><td>desert</td><td>wind</td><td></td></tr><tr><td>hot sauce</td><td>Antarctica</td><td></td></tr></table>	HOT	COLD		sun	ice cream		fire	snow		coat	popsicle		stove	ice		desert	wind		hot sauce	Antarctica	
HOT	COLD																					
sun	ice cream																					
fire	snow																					
coat	popsicle																					
stove	ice																					
desert	wind																					
hot sauce	Antarctica																					

<ul style="list-style-type: none"> Teacher Input, Modeling, & Checking for Understanding Guided Practice Independent Practice 	<p>2) With the students, brainstorm some objects that are hot and cold (refer to the previous table). The table suggests some answers that may be given by students.</p> <p>*It is important to note when making a chart that will be used to assess the students' understanding, to write down every idea a student offers. This is not a time to teach what belongs or does not belong in the chart. Use this time to check for the students' understanding of what you are discussing.</p> <p>Before students begin their independent activities, explain what they are going to be doing today. Ex: "Today, you get to use your own thermometers to measure the temperature for each glass of water! You get to record your results on this sheet where you will fill in what your thermometer looks like...Then guess what you get to do? You get to pick 4 things or places of your choice in our classroom to measure the temperature of! *Make sure you explain the sheets to your students so they have an understanding of what is expected of them.</p> <p>Now it is time for the students to investigate using their thermometers.</p> <ol style="list-style-type: none"> 1) Divide the class into groups of 4-5 students. 2) Give each group 1 thermometer, 1 cup of warm water, 1 cup of cold water. Each student should receive their own copy of the Cold/Hot temperature sheet, and Temperatures in My Classroom sheet. 3) Have the students fill in and label their thermometer temperature for each of the cups of water on their provided worksheets. (As students investigate, the teacher should be walking around the room assisting students). 4) Once students in each group have finished filling out their
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<ul style="list-style-type: none"> • Closure 	<p>thermometer worksheets pertaining to each cup of water, let them disperse individually and find the temperature of 4 things in the classroom. Students can place their thermometers next to windows, air vents, under desks, and other areas around the room.</p> <p>5) Next, they can record their findings on their Temperature in My Classroom! sheet.</p> <ol style="list-style-type: none"> 1) Once students have completed all 3 sheets, have them return as a group and sit on the floor. 2) Talk to the students about their temperature findings for the warm and cold cups of water. Ask them what the thermometer looked like. 3) Next, ask if any students would like to volunteer which items or places they found the temperatures of. Ask them to share what their thermometer looked like. 4) Have students turn in their sheets for evaluation
<p>Post-Assessment:</p>	<ul style="list-style-type: none"> • Assess student activity sheets. Understanding of the concepts will be evaluated using the Science Weather Unit Progress Check (Appendix A). • During independent practice, the teacher should walk around the room and take anecdotal notes as to whether students seem to be grasping the concept of temperature. • Assessing may also be done during closure/group discussion.

This lesson refers to Piaget's Theory of Developmental Processes in that children learn by stimulation of their mental processes. In other words, students can use their previous understanding of temperature to further develop their understanding of the world. By using the hot and cold chart in the beginning to

get students thinking about temperature, the students are given the opportunity to use their own schema or prior understanding. Moreover, in first grade, some students will be in the Preoperational Stage, while others will be in the Concrete Operational Stage, during which the children begin to think more theoretically (Harmon & Jones, 2005). Also at this stage, children are able to differentiate objects using simple terms such as big and small, light and heavy, and square and round. Thus, differentiating objects in regards to hot or cold temperatures is a perfect complement to this stage. It must also be addressed that not all children develop at the same rate, thus it is especially important to use a variety of manipulatives during science lessons. Without allowing the children to use thermometers to investigate, it would be nearly impossible for them to develop a well-rounded understanding of the objectives.

In addition, a selection of Gardner's multiple intelligences were brought into play during the "What is Temperature?" lesson. Verbal linguistic children prefer to receive information in the form of words through reading or other verbal aspects of learning (Lewis, 2004). Thus, the read aloud of *Hot and Cold*, by Jack Challoner is appealing to those children. Moreover, being a science lesson, the investigations of the hot and cold water, in addition to various temperatures around the room appealed to Gardner's next intelligence, logical mathematics. These types of children like to learn through experimentation or testing hypotheses (Lewis, 2004). Also, in connection with Piaget's Preoperational Stage, the use of a manipulative appeals to Gardner's kinesthetic intelligence. These children enjoy physical movement and learn best when they can touch

objects and interact with the space around them (Lewis, 2004). Still, this lesson correlates with yet another one of Gardner's multiple intelligences, the interpersonal intelligence. Children with this intelligence prefer to work in groups and learn best when they are able to collaborate with other people. Accordingly, the "What is Temperature?" lesson requests that students' first work in a group before leaving to work on the next activity in the lesson independently. Of Gardner's eight multiple intelligences, four of them are identified in the first lesson of this unit.

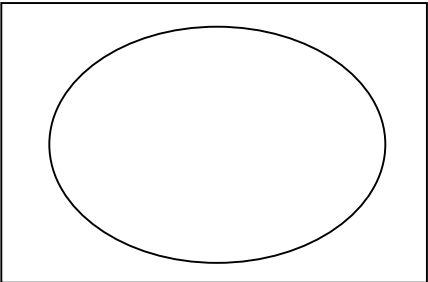
Lastly, by having an appealing anticipatory set, scientific inquiry is more likely to come into play for the students. In other words, it has been suggested that when students are curious about a characteristic of the world, they are more likely to use all of their senses to investigate (Lind, 2005). If teachers can get students interested in the topic, students are more likely to retain what they learn. Overall, when students are invited to use their inquiry process skills, they are encouraged to use their senses to discover aspects about the world around them. Any questions used to promote thinking will allow for success of these students when they are asked to use these skills at an older age. This lesson incorporates 5 of the 8 inquiry process skills needed for a successful scientific investigation: (a) observation, (b) compare and contrast, (c) classification, (d) measurement, and (e) communication.

Lesson 2: Seasons

Title:	The Seasons of the Year		
Content Area: Science		Grade: 1st	Duration: 1 hour 15 minutes
Standards and Benchmarks:	<u>State Standards:</u> <i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space <i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world. <i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.		
Objectives:	<ul style="list-style-type: none">• TSWBAT choose appropriate clothing for each season• TSWBAT determine appropriate activities for each season• Understand weather occurrences for each of the seasons		
Resources and Materials:	<ul style="list-style-type: none">• <i>Reasons For Seasons</i> by: Gail Gibbons• <i>Seasons of the Year</i> by: Meish Goldish• Large Paper• Magazines• Scissors• Glue• Science Weather Unit Progress Check (Appendix A)		
Differentiation:	*It is important when teaching this lesson to consider your students' backgrounds. You should think about where they came from and how that might change their views of weather. For		

	example, some of your students may have grown up in climates where the weather changed little or never at all.																				
<p>Preparing Students for the Lesson:</p> <ul style="list-style-type: none">• Transitions• Expected behaviors	<p>Before beginning the lesson, gets students’ schema going. Think about what kinds of questions you are going to ask them about the seasons. For example, “What happens to the weather during the winter, summer, spring, and fall? What types of activities can you do? How do the seasons affect what you where?”</p> <p>-While some students may know a lot about the changes that occur during a year, other students may not have sufficient background about the seasons.</p>																				
<p>Teaching the Lesson (Lesson Sequence/ Activities):</p> <ul style="list-style-type: none">• Motivation/ Anticipatory Set	<p>Begin the lesson by creating a chart that you can fill out as a class about the seasons. EX:</p> <table><tr><td></td><td>Winter</td><td>Summer</td><td>Spring</td><td>Fall</td></tr><tr><td>Activities</td><td></td><td></td><td></td><td></td></tr><tr><td>Clothes</td><td></td><td></td><td></td><td></td></tr><tr><td>Changes Outside</td><td></td><td></td><td></td><td></td></tr></table>		Winter	Summer	Spring	Fall	Activities					Clothes					Changes Outside				
	Winter	Summer	Spring	Fall																	
Activities																					
Clothes																					
Changes Outside																					
<ul style="list-style-type: none">• Pre-Assessment/ Activating	<p>This chart will serve as a pre-assessment to get a general consensus of what children already know about the seasons of the year.</p>																				

<p>Background Knowledge</p> <ul style="list-style-type: none"> Teacher Input, Modeling, & Checking for Understanding Guided Practice 	<p>While you are filling out this chart as a class, ask students questions to get their schema going. You could ask them questions such as: (a) What kind of activities do you do in the Winter/Summer?, (b) What kind of clothes are appropriate for Winter/Summer?, (c) Why is this so?, (d) What kinds of changes do you notice about trees during the year?, and (e) What kinds of things happen outside during Spring/Fall?</p> <p>Once students have had an opportunity to brainstorm some of their thoughts, have them gather in a group on the carpet and read them <i>Reasons For Seasons</i> by: Gail Gibbons.</p> <p>Next, teach them the song, <i>Seasons of the Year</i> by: Meish Goldish. Sung to the tune of Here We Go Round the Mulberry Bush, it goes like this...</p> <p style="text-align: center;"><i>CHORUS:</i></p> <p style="text-align: center;">Here we go round the year again, The year again, the year again. Here we go round the year again, To greet the different seasons.</p> <p style="text-align: center;">Wintertime is time for snow. To the south, the birds will go. It's too cold for plants to grow Because it is the winter.</p> <p style="text-align: center;">Here we go round the year again, The year again, the year again. Here we go round the year again, To greet the different seasons.</p> <p style="text-align: center;">In the springtime, days grow warm. On the plants, the new buds form. Bees and bugs come out to swarm Because it is the spring.</p> <p style="text-align: center;"><i>CHORUS</i></p>
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	<p>In summertime, the days are hot. Ice cold drinks I drink a lot! At the beach, I've got a spot Because it is the summer.</p> <p><i>CHORUS</i></p> <p>Fall is here, the air is cool. Days are short, it's back to school. Raking leaves is now the rule Because it is autumn.</p> <p><i>CHORUS</i></p> <p>This song can be repeated throughout the unit to remind students about the changes that occur during the year (Goldish).</p>
<ul style="list-style-type: none">• Independent Practice	<p>Now, students get to create a poster using magazine pictures to demonstrate what they know about the seasons.</p>  <ol style="list-style-type: none">1. Create a circle on a large piece of paper.2. Divide the circle into four equal sections.3. Next, label each section with a season of the year (Summer, Spring, Fall, Winter).4. Make copies for your class. <p>-Have the students cut out and glue pictures of things that relate to the seasons. Encourage them to look for season specific activities, clothing, and weather occurrences (The Seasons Science Activity).</p>

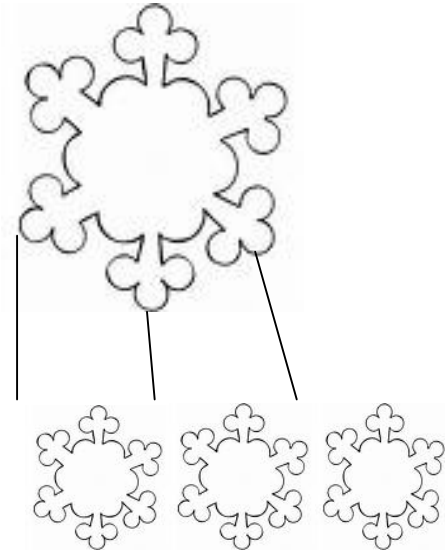
<ul style="list-style-type: none"> • Closure 	-For closure, give each student one minute to share and explain their poster with the class.
Post-Assessment:	<ul style="list-style-type: none"> • Student posters should be collected and evaluated using the Science Weather Unit Progress Check (Appendix A). • In addition, anecdotal notes can be taken while students are sharing their poster

In this lesson, Piaget's Theory of Developmental Processes is also brought into play. Students are given the opportunity to use previous knowledge in order to further develop their understanding of the seasons. The chart that is created during this lesson on the four seasons activates students' prior knowledge. Moreover, five of Gardner's multiple intelligences were utilized throughout the lesson. To begin with, students who learn in a verbal linguistic style would appreciate the read aloud of *The Seasons of Arnold's Apple Tree* by: Gail Gibbons because they prefer to learn through reading or other verbal aspects of learning (Lewis, 2004). Next, working with pictures from the magazines benefits students with spatial intelligence. These types of people prefer to learn through the use of color and pictures. Next, kinesthetic students, who like to move while learning, were supported according to Gardner's fourth intelligence. Still, perhaps one of Gardner's most overlooked intelligences when it comes to teaching is musical intelligence. These types of learners enjoy a variety of musical forms and can replicate melodies and rhythms quite easily (Harmon & Jones, 2005). *The Seasons of the Year* song addresses students with musical intelligence who may

remember details about the seasons due to their sensitivity to sounds. Lastly, intrapersonal learners, or students who take pride in creating something on their own and sharing it in a group setting are also benefiting from this lesson. In consideration of including inquiry process skills in the lesson, students are being asked to observe, compare, classify, and communicate about what they are learning.

Lesson 3: Winter

Title:	Winter & Snow		
Content Area: Science		Grade: 1 st	Duration: 1 hour
Standards and Benchmarks:	<p><u>State Standards:</u></p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Objectives:	<ul style="list-style-type: none">• TSWBAT identify other words for snow and winter• Understand the basic concepts of winter• Create a snowflake mobile		
Resources and Materials:	<ul style="list-style-type: none">• White or light blue paper• Scissors• Yarn (Preferably White)• <i>It’s Winter: Celebrate the Seasons</i> by Linda Glaser• Science Weather Unit Progress Check (Appendix A)		

<ul style="list-style-type: none"> Teacher Input, Modeling, & Checking for Understanding 	<p>Now it is time to show students what they are going to be making today (the teacher should have a complete model of the snowflake mobile to share with the class).</p>  <p>The large snowflake at the top of the mobile should say <i>Winter</i>. The smaller snowflakes extending from the larger snowflakes should have words or activities that describe Winter (cold, snowy, white, sledding, hats). A snowflake template should be used to ensure that students have adequate room to write their words (Paper Snowflakes For Children, 2008) Explain to the students how you assembled your mobile, using step by step instructions before sending them back to their seats to start the activity.</p> <ul style="list-style-type: none"> Guided Practice <p>During guided practice time, the teacher should be roaming around the room to assist students with their project.</p> <ul style="list-style-type: none"> Independent Practice <p>Students get to make their own snowflake mobile.</p>
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<ul style="list-style-type: none"> • Closure 	Hang the snowflake mobiles above students' desks not just because it will look impressive, but as a reference for students to look at.
Post-Assessment:	Use student group time, independent time, and the final project to evaluate each student's growth using the Weather Science Unit Progress Chart (Appendix A).

In this lesson, students have the opportunity to expand their knowledge of winter. They are able to use their previous understanding of winter to expand their knowledge and vocabulary. In addition, starting the lesson with a read aloud engages students and stimulates them into using a variety of their senses. When students are presented with an appealing anticipatory set, the students are more likely to use a variety of senses to learn (Lind, 2005). While an alluring anticipatory set such as the read aloud of, *It's Winter: Celebrate the Seasons* by Linda Glaser engages most students, it is particularly attractive to the students who possess a verbal linguistic way of learning. Moreover, designing the mobile itself sparks the interest of spatial intelligence learners. Similarly, cutting and building the mobiles appeals to kinesthetic learners. By including the song *It is Winter* in the lesson, students are being provided with another learning opportunity, especially musical intelligence learners. Furthermore, students who learn best on their own, intrapersonal learners, also have the chance to shine in this lesson. Lastly, even though students are not performing a scientific experiment, they are still using inquiry process skills. They are being encouraged

to use their senses in order to learn about the world around them. The students are using their skills to observe and communicate.

Lesson 4: Spring

Title:	April Showers		
Content Area: Science		Grade: 1st	Duration: 1 hour
Standards and Benchmarks:	<p><u>State Standards:</u></p> <p><i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.</p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Objectives:	<ul style="list-style-type: none">• TSWBAT understand the importance of rain• TSWBAT have a basic understanding of the water cycle		
Resources and Materials:	<ul style="list-style-type: none">• Plastic Bags (one for each student)• Small sponges (one for each student)• Colorful paper frame made from cardstock to put around their bag.• <i>April Showers</i> worksheet (Appendix A)• <i>The Magic School Bus Wet All Over: A Book About the Water Cycle</i> by Joanna Cole• Science Weather Unit Progress Check (Appendix A)		

Differentiation:	For the students who had a difficult time pinpointing the four different seasons of the year, this lesson will give them another opportunity to learn about Winter in more detail.								
<p>Preparing Students for the Lesson:</p> <ul style="list-style-type: none"> Transitions 	<p>Start the lesson by asking students if any of them remember what the weather is like in the Springtime. Make notes on the following chart based on what your students responses are:</p> <table border="1"> <tr> <td></td><td>SPRING</td></tr> <tr> <td>Activities</td><td></td></tr> <tr> <td>Clothes</td><td></td></tr> <tr> <td>Changes Outside</td><td></td></tr> </table> <p>This will activate student schema.</p>		SPRING	Activities		Clothes		Changes Outside	
	SPRING								
Activities									
Clothes									
Changes Outside									
<ul style="list-style-type: none"> Expected behavior 	While some students will remember what they learned from the previous lesson. Others will need some reminding. Use prompting questions to get students thinking.								
<p>Teaching the Lesson (Lesson Sequence/ Activities):</p> <ul style="list-style-type: none"> Motivation/ Anticipatory Set 	<p>Once you have had a chance to revisit the basic characteristics of Springtime introduce <i>The Magic School Bus Wet All Over: A Book About the Water Cycle</i> by Joanna Cole to the class as a read aloud. After reading the book to the class, ask students questions about the book. After reading the book, you can teach your students the following song (sang to the tune of She'll Be Coming Around the Mountain):</p>								

	<p style="text-align: center;"><i>Water Cycle</i></p> <p style="text-align: center;"><i>Water travels in a cycle, yes it does</i> (use pointer finger to make a big circle)</p> <p style="text-align: center;"><i>Water travels in a cycle, yes it does</i> (repeat circle with finger)</p> <p style="text-align: center;"><i>It goes up as evaporation</i> (move hands up to the sky)</p> <p style="text-align: center;"><i>Forms clouds as condensation</i> (make a cloud overhead with arms)</p> <p style="text-align: center;"><i>Then comes down as precipitation, yes it does!</i> (sprinkle fingers down to the floor) (Phelan)</p>
<ul style="list-style-type: none"> • Pre-Assessment/ Activating Background Knowledge 	<ol style="list-style-type: none"> 1) Now it is time to start a mini discussion Gather the students into a group on the floor and start a discussion. 2) Ask them questions like, “Do you like the rain?” “What activities do you like to do in the rain?” “Why might rain be important?” “Where do you think rain comes from?” 3) Briefly make a list with your students about the different types of water resources (oceans, rivers, lakes, clouds)
<ul style="list-style-type: none"> • Teacher Input, Modeling, & Checking for Understanding 	<p>Now it is time to start the “Rainy Day in a Bag” activity. Explain to the students what they get to create their own rainy day! Model for the students, using an already made example what their finished product will look like and briefly explain how to assemble the project.</p>

<ul style="list-style-type: none"> • Guided Practice • Independent Practice 	<p>While students are constructing their “Rainy Day in a Bag” activity, the teacher should be walking around to assist the students who are struggling.</p> <ol style="list-style-type: none"> 1) Give each student a frame the size of a sandwich bag to color and decorate 2) Next, give each student one sandwich bag and a tiny sponge 3) Have the students wet their sponge and place it into their baggy 4) Seal the bag shut so there are no openings 5) Have the students tape the frame onto their bag 6) Tape the bags onto a sunny window when the students have completed the activity 7) Have the students predict what will happen on their <i>April Showers</i> graphic organizer. 8) Finally, let the students observe what has happened inside their bags (there will be drops of condensation) 9) Lastly, students will describe what happened to their bags on the second part of the <i>April Showers</i> graphic organizer.
<ul style="list-style-type: none"> • Closure 	<ol style="list-style-type: none"> 1) Have the students gather in a group on the rug to discuss their findings 2) Explain to the children that clouds are made of tiny drops of water like those that are in their bags. 3) You can let them know that rain falls out of the clouds when the air cools 4) Explain to the children that they made rain fall from their cloud (sponge)
<p>Post-Assessment:</p>	<p>Use the Science Weather Unit Progress Chart to keep track of student progress. The <i>April Showers</i> worksheet can be used to assess student learning based on their predictions of what would happen versus what they observed happen. In addition, assessment can be recorded using the Science Weather Unit Progress Chart.</p>

This lesson has several characteristics of an effective science unit. The activities and inquiry process skills throughout this lesson encourage scientific literacy. By the end of the lesson, children will have a general understanding of the fundamentals of science. In addition to some of the previous lessons, Piaget's Theory of Developmental Processes continues to be a feature in this lesson. At Piaget's Concrete Operational Stage, children are beginning to think in a more theoretical manner (Harmon & Jones, 2005). Thus having children predict and make inferences on what a specific conclusion may be, allows them to develop in this stage appropriately. Also at this stage, children enjoy working with concrete materials to enhance their learning of a subject. Therefore, another reason as to why this lesson is scientifically correct.

Equally important, several of Gardner's multiple intelligences are brought into play during this lesson. Every child has a unique learning style and a preferred method when receiving information, so it is important for the teacher to address as many of the intelligences in a lesson they can (Lind, 2005). In the beginning of the lesson, the read aloud of *The Magic School Bus Wet All Over: A Book about the Water Cycle* by Joanna Cole is directed to the students who prefer a verbal linguistic teaching style, or learning through reading and listening. Another intelligence that seems to be more prevalent among young children is kinesthetic. These people like to learn using concrete objects and materials. This lesson includes the use of several materials for an activity that is aimed at students with kinesthetic intelligence. Also, some children learn well through melodies

and rhythms. These types of students can hear a song once or twice and have it memorized from start to finish. For this reason it is valuable to include educational music in lessons when at all possible. For instance, the *Water Cycle* song in this lesson is a perfect example of this. The last of Gardner's intelligences identified in this lesson is intrapersonal. In this lesson, students are expected to work independently during completion of their April Showers worksheet, which is pleasing to the person with intrapersonal intelligence. As far as Inquiry process skills, there are many in this lesson. For example, students are being asked to *observe* their rainy day bags. Also, they are being encouraged to predict what is going to happen, and communicate their results. Overall, this lesson is another exemplar of a well-rounded science lesson.

Lesson 5: Summer

Title:	Sun Savvy		
Content Area: Science	Grade: 1 st	Duration: 1 hour	
Standards and Benchmarks:	<ul style="list-style-type: none">• TSW (The Students Will) understand that the sun is the reason for the seasons.• TSW learn that the sun is actually a star• TSWBAT identify why the sun is important for life on our earth• TSWBAT determine that the sun is the reason for keeping our earth cold, cool, warm, or hot.		
Objectives:	<p><u>State Standards:</u></p> <p><i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.</p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Resources and Materials:	<ul style="list-style-type: none">• <i>Sunshine Makes the Seasons</i> by Franklyn Mansfield Branley• Three plastic containers of water		

	<ul style="list-style-type: none"> • Warmth Chart (Appendix A) • Science Weather Unit Progress Chart (Appendix A)
Differentiation:	For the students who had a difficult time pinpointing the four different seasons of the year, this lesson will give them another opportunity to learn about Summer in more detail.
<p>Preparing Students for the Lesson:</p> <ul style="list-style-type: none"> • Transitions • Expected behaviors 	<p>Before teaching this lesson, there is a great deal of preparation involved. Make sure to set out plastic containers with water in the three areas several hours before the lesson. One pan of water will stay in the classroom, one in a shaded area outside, and one in the hot sun.</p> <p>Have students begin by sitting in a group on the floor. Get students thinking about the four seasons. Ask your students if any of them remember what they have learned about Summer thus far. Use the whiteboard to record student responses. These responses can later be used as a pre-assessment tool.</p> <p>While some students will remember what they learned from the previous lesson. Others will need some reminding. Use prompting questions to get students thinking.</p>
<p>Teaching the Lesson (Lesson Sequence/ Activities):</p> <ul style="list-style-type: none"> • Motivation/ Anticipatory Set • Pre-Assessment/ Activating Background Knowledge 	<p>After organizing students' thoughts about Summer on the whiteboard, read <i>Sunshine Makes the Seasons</i> by Franklyn Mansfield Branley.</p> <p>After reading the story, ask students if they are able to make any text-to-self connections with the story. Have students share some of the activities and experiences they have had during Summer. Prompt students with questions about the sun such as, (a) When you are cold, what types of activities do you use to stay warm? (b) Is it usually warmer during the day or night? Why? (c) What is the sun? And (d) What types of things does the sun do?</p>

<ul style="list-style-type: none"> • Teacher Input, Modeling, & Checking for Understanding • Guided Practice • Independent Practice • Closure 	<p>Next, explain the students that they get to participate in an experiment. Show the class an example of the warmth chart and let them know that they will be going to three different areas of the school, the classroom, outside in the sun, and outside in a shaded area. They will be observing the differences in warmth in each of these areas.</p> <p>Starting in the classroom, ask students the following questions in each of the three areas:</p> <ul style="list-style-type: none"> • How warm or cold does it feel in our classroom? The shade? The sun? • Why do you think this? • Do you think the heat of the sun is helping to warm this area? Why or Why not? <p>Students will need to touch the water in the pan at each area, and circle either (cold, cool, warm, and hot) and write a sentence describing what they observed.</p> <p>After the class has had a chance to visit each of the three areas, have students return to a group on the floor. Ask the students questions about what they discovered: Which area did you think was the warmest? Why do you think this was?</p>
Post-Assessment:	<p>Besides looking over their warmth charts, students can be evaluated on their answers to questions such as (a) How do people, plants, and animals rely on the sun? And (b) What might happen to the earth if there were no sun? Use the Science Weather Unit Progress Chart to keep track of student progress.</p>

Notes & Reflections:	This lesson will need to be done on a hot, sunny day.
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This Sun Savvy lesson encourages the stimulation of the children's mental processes. The way this unit is set up, the students obtained some background knowledge about summer during the lesson on seasons, and thus can use that information to develop a more in depth understanding of the sun. Moreover, this lesson correlates with Piaget's Preoperational and Concrete Stage, in that the children are able to differentiate between the temperatures of the water at each location. Through the use of these manipulatives, students are given a better chance at developing a well-rounded insight of the objective. In addition to Piaget's Theory of Developmental Processes, several of Gardner's multiple intelligences are brought about. To begin with, the read aloud of *Sunshine Makes the Seasons* by: Franklyn Mansfield Branley, appeals to the children who possess a verbal linguistic learning style, and prefer to learn through the use of words. Another one of Gardner's intelligences employed in this lesson is that of kinesthetic intelligence. Moving from location to location and getting to experiment with water is highly alluring for the kinesthetic learner. Also, working together as a class, yet being able to develop individual responses engage both the interpersonal and intrapersonal students. The last of Gardner's intelligences that is acknowledged in this lesson is his eighth and final intelligence, the naturalist. These types of learners prefer to work outdoors in a more natural setting. Therefore, being able to work outside for part of the

duration of this lesson is highly attractive to the naturalist learner. Lastly, it is important to remember to retain a sense of enthusiasm throughout the lesson. This gets students excited about what they are learning about. Likewise, when students are curious, they are more likely to use all of their senses to experiment (Lind, 2005). To sum up, numerous inquiry process skills are present throughout this lesson. Students are being asked to observe, compare, measure, and communicate, all facets of the inquiry process.

Lesson 6: Autumn

Title:	An Apple Tree Year		
Content Area: Science	Grade: 1 st	Duration: 1 hour 20 min.	
Standards and Benchmarks:	<u>State Standards:</u> <i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. <i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world. <i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling. <i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.		
Objectives:	<ul style="list-style-type: none">• TSWBAT identify general characteristics of Autumn• TSW collect and compare leaves• TSWBAT arrange groups of leaves according to varying characteristics		
Resources and Materials:	<ul style="list-style-type: none">• <i>When Autumn Falls</i> by Kelly Nidey & Susan Swan• An assortment of Leaves• Leaf Comparison Packet (Appendix A)• Science Weather Unit Progress Check (Appendix A)		
Differentiation:	Students will work in groups during this lesson. Some students may have a difficult time classifying the leaves into particular categories; therefore it is important to pair high and low students together.		

<p>Preparing Students for the Lesson:</p> <ul style="list-style-type: none"> • Transitions • Expected behaviors 	<p>Ask students to volunteer what they already know about Autumn. Remind them how they learned about the different seasons already and see if this sparks any memories. Students should have a general background of Autumn and be able to identify the changes that take place.</p>
<p>Teaching the Lesson (Lesson Sequence/ Activities):</p> <ul style="list-style-type: none"> • Motivation/ Anticipatory Set 	<p>Start the lesson by having students sit in a group on the floor. Do a read aloud with the book, <i>When Autumn Falls</i> by Kelly Nidey & Susan Swan. This will get them thinking about Autumn and text to self connections they may have with the story. Also, the song <i>The Leaves on the Tree</i> by: Barbara Pratt can be taught to the children for enrichment.</p> <p style="text-align: center;"><u>The Leaves on The Tree</u> Sung to: "The Wheels on The Bus" Copyright © 2000 Barbara Pratt. All rights reserved.</p> <p style="text-align: center;">The leaves on the tree are falling down, falling down, falling down. The leaves on the tree are falling down, Red, yellow, orange, and brown.</p> <p style="text-align: center;">(Have the child/children pretend they are crunching leaves on the ground while singing this verse.)</p> <p style="text-align: center;">The leaves on the ground go crunch, crunch, crunch crunch, crunch, crunch, crunch, crunch, crunch. The leaves on the ground go crunch, crunch, crunch. All through autumn (fall).</p> <p style="text-align: center;">Repeat verse 1</p> <p style="text-align: center;">Notes: If you like, you can go outside and sing the song.</p>

<ul style="list-style-type: none">• Pre-Assessment/ Activating Background Knowledge	<p>After reading the story, use a KWL chart to infer about what they know, want to know, and later, what they have learned.</p> <table><tr><th>KNOW ABOUT FALL?</th><th>WANT TO KNOW ABOUT FALL?</th><th>LEARNED ABOUT FALL?</th><th></th></tr><tr><td></td><td></td><td></td><td></td></tr></table>	KNOW ABOUT FALL?	WANT TO KNOW ABOUT FALL?	LEARNED ABOUT FALL?					
KNOW ABOUT FALL?	WANT TO KNOW ABOUT FALL?	LEARNED ABOUT FALL?							
<ul style="list-style-type: none">• Teacher Input, Modeling, & Checking for Understanding	<ol style="list-style-type: none">1. Explain to the students that today they are going to be collecting leaves. Encourage them to pick leaves with different characteristics such as size, color, and shape.2. Show them the Leaf Comparison Packet that they will be completing at the completion of this experiment.3. The teacher should have completed one category to share with the class as a model.4. In addition, the teacher will need to demonstrate how to do a leaf rubbing before students divide into their groups.								
<ul style="list-style-type: none">• Guided Practice	<ol style="list-style-type: none">1. As you take students outside, guide them while they find a variety of leaves. The teacher should observe students while they collect leaves to make sure they are on the right track.2. Once all of the students have had an opportunity to accumulate a number of leaves and you have returned to the classroom, divide the students into groups of 4-5.3. Each student should get a copy of the Leaf Comparison Packet and is expected to turn one in, however, this is a group activity and students may collaborate with each other.4. Explain to the class that each group will need to divide their leaves into three categories: size, shape, and color.								

	<p>5. On each sheet, the students need to make leaf rubbings of their leaves and write describing words in each section.</p> <p>6. If any individuals or groups are done early, see if they can think of a new category they can divide the leaves into.</p>
<ul style="list-style-type: none"> • Independent Practice • Closure 	<p>Students will disperse and work in their groups.</p> <p>Once a majority of the students have completed their Leaf Comparison packet, gather the students to the floor and have each group discuss what they discovered. The teacher should finish filling out the KWL chart while each group presents.</p>
Post-Assessment:	The Leaf Comparison packet can be used to assess how well students grasped the concepts and objectives of the lesson. Use the Science Weather Unit Progress Check to record student achievement.
Notes & Reflections:	This lesson will need to be done when there are leaves available on the trees or ground to evaluate.

Like some of the other lessons in the unit thus far, this lesson also addresses Piaget's Theory of Developmental Processes due to the fact that the students are being asked to sort and compare. Children in the Concrete Operational stage are able to begin to classify objects. Because not all students develop at the same rate, it is important to develop group activities to offer support to the students who are still maturing. In this lesson, students who have reached this level of development are given the opportunity to practice their new skills. On the other hand, allowing the students to work in groups, allows

scaffolding to take place for the students who are still in Piaget's Preoperational Stage. The first of Gardner's intelligences adopted in this lesson is the verbal linguistic. Students who enjoy learning by listening and reading words can benefit from the read aloud of *When Autumn Falls* by Kelly Nidey and Susan Swan. These types of students can absorb words like a sponge and remember stories they read even years later. Next, Gardner's second identified intelligence, logical mathematics, is recognized for the first time in this science weather unit. Logical mathematics learners prefer to use logic, numbers, and patterns to solve problems (Harmon & Jones, 2005). These students enjoy experimentation and display qualities such as, (a) abstract pattern recognition, (b) inductive reasoning, (c) deductive reasoning, (d) discerning relationships & connections, (e) performing complex calculations, and (f) scientific reasoning (Kolb, 1984). The classification of the leaves into groups falls into the logical mathematics category of learning. Along with the intelligences attended to thus far, kinesthetic intelligence is acknowledged once again. The students are free to move around and get to collect leaves of which they will later use to complete leaf rubbings. Musical intelligence is also distinguished yet again in regards to the song *The Leaves on the Tree* by Barbara Pratt. As well, students who encompass an interpersonal intelligence will appreciate the requirement to work in groups towards the end of this lesson. Lastly, students with natural intelligence who appreciate nature will be excited to work outside.

Finally, many inquiry skills are present throughout this lesson. The first skill, observation, is apparent in this lesson and without this, no one would be able to

obtain any information from the external world (Lind, 2005). Also, students are being asked to compare leaves that they have collected, which is another piece of the inquiry. Lastly, communication between teacher and student is required for the duration of the entire lesson, yet another example of an inquiry process skill.

Lesson 7: Clouds

Title:	What is a Cloud?		
Content Area: Science		Grade: 1st	Duration: Several days
Standards and Benchmarks:	<u>State Standards:</u> <i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems ant the structure and dynamics of earth and other objects in space. <i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world. <i>Reading and Writing Standard 2-</i> Students write and speak for a variety of audiences and purposes. <i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling. <i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.		
Objectives:	<ul style="list-style-type: none">• TSWBAT identify the common types of clouds.• TSWBAT come up with simple explanations of the weather associated with cirrus, stratus, cumulous, and cumulonimbus clouds.• TSW create their own cloud book at the end of the lesson.		
Resources and Materials:	<ul style="list-style-type: none">• <i>Cloud Book by: Tomie de Paola</i>• Large cloud cutout• Strip of blue bulletin-board paper• Crayons• Glue• Cotton balls		

	<ul style="list-style-type: none"> Science Weather Unit Progress Check (Appendix A)
Differentiation:	Being able to classify clouds may be difficult for some first graders. To overcome this, allow the students to work with partners during the observation periods outside.
Preparing Students for the Lesson: <ul style="list-style-type: none"> Transitions Expected behaviors 	<p>Let the children know that for the next few days they get to be weather reporters! Explain to them that they are going to be learning about clouds and the different type of weather associated with them.</p> <p>Most students are going to lack background knowledge in this area, so it is up to the teacher to explain the concept of clouds in terms they can understand.</p>
Teaching the Lesson (Lesson Sequence/ Activities): <ul style="list-style-type: none"> Motivation/ Anticipatory Set 	<p>Read <i>The Cloud Book</i> by Tomie de Paola out loud to the class. This is a kid-friendly book that is quite detailed about the different types of clouds and what types of weather they bring. Also, teach the students the following song about clouds (sang to the tune of Twinkle, Twinkle, Little Star). This song will also help reiterate the concepts mentioned in <i>The Cloud Book</i>.</p> <p style="text-align: center;"> <i>Cirrus, cirrus, in the sky, You're the ones that float so high.</i> </p> <p style="text-align: center;"> <i>Up above the earth you fly, Like a blanket in the sky.</i> </p> <p style="text-align: center;"> <i>Cirrus, cirrus, in the sky, You're the ones that float so high.</i> </p> <p style="text-align: center;"><i>Additional Versus:</i></p> <p style="text-align: center;"> <i>Stratus, stratus, high and gray, You can hide the sun away.</i> </p>

*Cumulus, cumulus, bouncy and white,
You make shapes for our delight.*

*Nimbus, nimbus, dark and gray,
Guess I won't go out to play!*

- Pre-Assessment/
Activating
Background
Knowledge

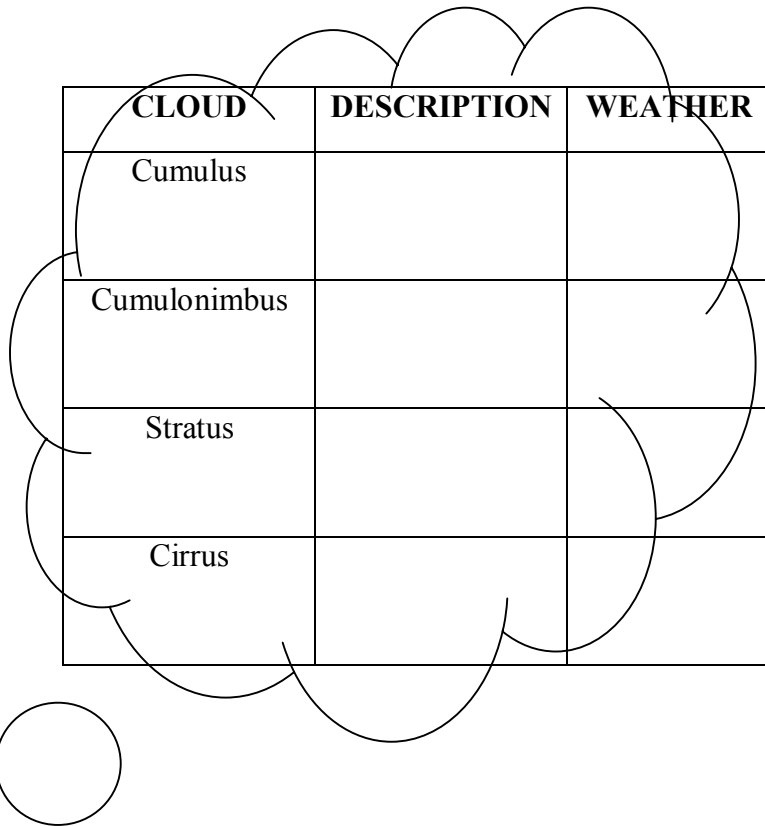
Explain to students that clouds are tiny droplets of water. Help them understand that there are many different types of clouds that are associated with different weather patterns.

Have students share their experiences with clouds to activate their schema

- Teacher Input,
Modeling, &
Checking for
Understanding

- 1) After reading the book, write a student generated list of the different types of clouds on the large cloud cutout.
- 2) Next, have students volunteer brief descriptions about the characteristics of those clouds to add to the cloud cutout.

CLOUD	DESCRIPTION	WEATHER
Cumulus		
Cumulonimbus		
Stratus		
Cirrus		



<ul style="list-style-type: none"> • Guided Practice • Independent Practice • Closure 	<ol style="list-style-type: none"> 1. For several days in a row, as a group, go outside and have the students observe the clouds. 2. Have the students bring their science journals and draw pictures of what they see. 3. See if they can make predictions about the weather based on the clouds they see. 4. Once the students have a general understanding of the different types of clouds over a period of a few days, independent practice can follow. <ol style="list-style-type: none"> 1) Students will make a “cloud book.” 2) Give each student a strip of blue bulletin-board paper that is 5 inches tall and 3 feet long that has been folded accordion-style (make each fold a 5 by 5 inch square). 3) Have the students write their name and the title “My Cloud Book,” on the cover. 4) On the bottom of each page, have the students name and describe a different type of cloud, they can use their pictures and notes from their observations. 5) Next, the students can use crayons and cotton balls to create resemblances of their clouds on the top part of the page. <ol style="list-style-type: none"> 1) Use sticky notes to cover up the names of the types of clouds in “The Cloud Book,” 2) Have the students gather on the floor and read them “The Cloud Book,” one last time. 3) The students must rely on the pictures to determine what type of cloud is on each page. This can be an interactive reading with the students, let them read along with you.
<p>Post-Assessment:</p>	<p>The final project, My Cloud Book, can be used as a tool for assessment. In the same way, the Science Weather Unit Progress Chart can be used to record student understanding.</p>

Notes & Reflections:	It is best to do this lesson during the late Spring, early Summer months when clouds are most prevalent.
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In this lesson, according to Piaget's Theory of Developmental Processes, children are being asked to invigorate their mental processes as a result of using their background understanding of weather and clouds, to further develop their understanding of the world. Like the other lessons in this unit, several of Gardner's multiple intelligences are intertwined throughout the lesson. To repeat, the read aloud of the *Cloud Book* by: Tomie de Paola engages students who inherent a verbal way of learning. Moreover, students who acquire spatial intelligence will thrive on the individual cloud book activity at the end of the lesson. These types of learners prefer to work with pictures. They are also very detail oriented and like to put things together. Similarly, the kinesthetic learners will enjoy the final project as well. They are able to use their hands to assemble their own cloud book, using various materials such as cotton balls and large pieces of paper. In addition, the kinesthetic learners will look forward to being able to move from the classroom and outside to make daily observations. Next, while musically intelligent people are commonly left out, they are not forgotten in this well-rounded lesson. Also, because this lesson spans several days, students get the chance to work both independently and in groups. This means that both interpersonal and intrapersonal learners will have a chance to shine. Lastly, because a lot of this lesson requires being outside, the naturalist learner is also

accredited. Additionally, there is an abundant amount of inquiry process skills within this extended lesson. Because the students are given the opportunity to use all of their senses to learn about clouds, observation is able to take place. Besides that, students are given ample time to compare during their observations of the clouds. Not only are they asked to observe and compare, but they must then classify each cloud into a category and hypothesize what type of weather is associated with that particular cloud. Lastly, they are expected to communicate what they have learned at the end of the lesson when making their own cloud books.

Lesson 8: Wind

Title:	What is Wind?		
Content Area: Science		Grade: 1st	Duration: 1 hour 15 min.
Standards and Benchmarks:	<u>State Standards:</u> <i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations. <i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems ant the structure and dynamics of earth and other objects in space. <i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world. <i>Reading and Writing Standard 2-</i> Students write and speak for a variety of audiences and purposes. <i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling. <i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.		
Objectives:	<ul style="list-style-type: none">• TSW understand that wind can make objects move.• TSWBAT recognize that wind can blow fast or slow.• TSWBAT describe existing weather conditions by collecting and recording weather data• TSWBAT select and use simple devices to gather data related to an investigation• TSWBAT communicate about investigations and explanations		
Resources and Materials:	<ul style="list-style-type: none">• <i>The Tiny Seed</i> by Eric Carle• Fan• Construction paper		

	<ul style="list-style-type: none"> • Plastic straws • Brass fasteners • Pinwheel template (Appendix A) • Traveling Pinwheel Worksheet (Appendix A) • Science Weather Unit Progress Check (Appendix A)
Differentiation:	<ul style="list-style-type: none"> • For ESL students it is important to define weather vocabulary. • Also, it is important to note that the children need help putting their pinwheels together. • Students will need step by step instructions on how to build their pinwheel.
Preparing Students for the Lesson: <ul style="list-style-type: none"> • Transitions • Expected behaviors 	<p>Talk to the students about how wind makes things move. Introduce the lesson by explaining to them that wind is an occurrence of the weather.</p> <p>Students should have a comparable background about the wind, however, this lesson is meant to create a more in depth understanding.</p>
Teaching the Lesson (Lesson Sequence/ Activities): <ul style="list-style-type: none"> • Motivation/ Anticipatory Set 	<p>Read <i>The Tiny Seed</i> by Eric Carle out loud to the class. Check for comprehension by asking the class questions about the story. In keeping with the song theme throughout the unit, teach the students <i>The Wind</i> from Mrs. Bee's webpage (Whatever the Weather, 2003).</p> <p style="text-align: center;"> <u>The Wind</u> (Tune: The Muffin Man) The wind is full of tricks today </p>

	<p>It's almost blew me far away. It almost knocked me off my feet, As I came walking down the street!</p> <p>The next time that I go outside The wind won't take me for a ride I know just what I will do I'll put some glue on the bottom of my shoe!</p>									
<ul style="list-style-type: none">Pre-Assessment/ Activating Background Knowledge	<p>Go over the following:</p> <p><u>Facts about the Wind</u></p> <p>~Air cannot be seen but it is all around us. ~Wind is air that is moving fast. ~Wind makes things like windmills, kites, leaves and clouds move around. ~Wind is important to our weather. ~A weather vane shows us which way the wind is blowing (Whatever the Weather, 2003).</p> <p>Use a KWL chart to find out what the students already know, want to know, and to assess what they have learned by the end of the lesson about wind.</p> <table><tr><th>KNOW ABOUT WIND?</th><th>WANT TO KNOW ABOUT WIND?</th><th>LEARNED ABOUT WIND?</th><th></th></tr><tr><td></td><td></td><td></td><td></td></tr></table>	KNOW ABOUT WIND?	WANT TO KNOW ABOUT WIND?	LEARNED ABOUT WIND?						
KNOW ABOUT WIND?	WANT TO KNOW ABOUT WIND?	LEARNED ABOUT WIND?								
<ul style="list-style-type: none">Teacher Input, Modeling, & Checking for Understanding	<p>Next, use the fan to move a variety of objects in the classroom, have students predict what they think will happen to the objects before the fan is placed towards them. Ask the students questions such as “Do you think the paper or the rock can be blown farther?”</p>									

<ul style="list-style-type: none"> • Guided Practice • Independent Practice • Closure 	<ul style="list-style-type: none"> • First, the students are going to make a pinwheel which they will use later. • Give each student a pinwheel template and a plastic straw. • Have the students color and design their pinwheel before cutting them out and then cutting on the dotted lines. • Have the children fold each corner of their pinwheel onto the center hole and help them place a brass fastener in the center to hold the corners in place. • Now it is time to have the students test out their pinwheel. • Have the students take their pinwheel outside to see if it moves. See if they can tell if there is a breeze or not using their pinwheel. • Ask them questions such as “is the wind strong enough to make your pinwheel spin?” Does it spin when you blow on it?” “Do you have to blow on it hard?” • Have the students report what they have learned using their Traveling Pinwheel worksheet. 1) Gather the students on the floor for a final group discussion 2) Ask them what they learned about the wind today, completing the L column on the KWL chart 3) Ask if there are any students that would like to share what they discovered about the wind and their pinwheel today
<p>Post-Assessment:</p>	<p>Use the Traveling Pinwheel worksheet and completed KWL chart to calculate understanding. Record results of each student on the Science Weather Unit Progress Check.</p>

Notes & Reflections:	This lesson works best on a windy day!
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The activity, making a pinwheel, in this lesson, refers to Piaget's Theory of Developmental Processes. Children like to use a variety of resources when learning something new. Thus, the pinwheel acts as a manipulative, allowing for students to gain a deeper grasp of the concepts being taught. Further, a number of Gardner's multiple intelligences are also a part of this lesson. To begin with, every lesson in this unit thus far has touched on the verbal intelligence, and this one is no different. A read aloud allows for verbal learners to listen to the story and absorb what they are being told. Indeed, *The Tiny Seed* by Eric Carle is a wonderful resource for this lesson. Next, Gardner's fourth intelligence, kinesthetic, is integrated into this lesson. Not only does constructing a pinwheel apply to this intelligence, but anytime there is movement from the classroom to another area of the school, this aptitude is brought into play. Also, musical intelligence, Gardner's fifth intelligence, is again highlighted in this lesson. Some students learn melodies and rhythms exceptionally easily. Therefore, a well-learned song will never be forgotten. In this activity, students are asked to work independently, thus addressing those with intrapersonal preference. Last of Gardner's intelligences acknowledged in this lesson is his eighth and final intelligence, the naturalist. Being that this is a science activity requiring the outdoors and the use of natural elements in nature, children with naturalistic tendencies will be fond of this lesson. Nevertheless, there are also many inquiry

process skills in this lesson. This is vital to future scientific literacy of the students because they need time to become skilled in this area. Not only should students be asked to answer difficult questions, but it should be mandatory to use more than one scientific method during experimentation. In this lesson alone, the students are being asked to *predict* the outcome of wind on certain objects, *observe* the wind outside, *measure* how strong the wind is, and *communicate* their findings in writing. Thus four of the eight scientific inquiry methods are present in this lesson.

Lesson 9: Lightning

Title:	Lightning Safety		
Content Area: Science		Grade: 1 st	Duration: 1 hour
Standards and Benchmarks:	<p><u>State Standards:</u></p> <p><i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations</p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 2-</i> Students write and speak for a variety of audiences and purposes.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Objectives:	<ul style="list-style-type: none">• TSW have a general understanding of lightning and some safety procedures.• TSWBAT define lightening as an energy source that can be dangerous.• TSW get to create their own “Mouth Lightning”		
Resources and Materials:	<ul style="list-style-type: none">• <i>Flash, Crash, Rumble, and Roll</i> by Franklyn M. Branley & True Kelley		

	<ul style="list-style-type: none"> • Wint-O-Green or Pep-O-Mint Lifesavers (enough for the entire class). • Dark Room • “Mouth Lightning” Graphic Organizer (Appendix A) • Science Weather Unit Progress Check (Appendix A)
Differentiation:	<ul style="list-style-type: none"> • For ESL students it is important to define new weather terms. • Also, it is important to note that some children may have never seen lightning before, therefore, it is vital that you provide numerous pictures and examples of lightning.
Preparing Students for the Lesson: <ul style="list-style-type: none"> • Transitions • Expected behaviors 	<p>Explain to students that lightning is an example of static electricity. Ask them if they have ever gotten shocked when they have touched something metal or rubbed their feet on the carpet. Let students discuss any experiences they may have had with static electricity or lightning. In addition, help children understand that thunder occurs when lightning strikes.</p>
Teaching the Lesson (Lesson Sequence/ Activities): <ul style="list-style-type: none"> • Motivation/ Anticipatory Set • Pre-Assessment/ Activating Background Knowledge 	<p>Begin the lesson by reading <i>Flash, Crash, Rumble, and Roll</i> by Franklyn M. Branley and True Kelley. This book explains how and why a thunderstorm occurs and what actions to take when lightning is present.</p> <p>A KWL chart is a great way of identifying what your students already know and what you can teach them about lightning. The following is an example of how the chart might be set up.</p>

	Know About Lightning?	Want to Know About Lightning?	Learned About Lightning

- Teacher Input, Modeling, & Checking for Understanding

Now it is time to go over some safety tips about lightning with your students. Discuss the following:

- Stay or go indoors!**
- Stay away from anything that could conduct electricity.** This includes fireplaces, radiators, stoves, metal pipes, sinks, and phones.
- Stay in your automobile if you are traveling.** Automobiles give you excellent lightning protection.
- Don't use metal objects outside,** like fishing rods and golf clubs. Golfers wearing cleated shoes are really good lightning rods.
- Get out of the water.** This includes getting off small boats on the water.
- If you're outdoors, seek shelter from lightning!** Buildings are best for shelter, but if no buildings are available, you can find protection in a cave, ditch, or a canyon. Trees are not good cover! Tall trees attract lightning.
- If you can't find shelter, avoid the tallest object in the area.** If only isolated trees are nearby, your best protection is to crouch in the open, keeping twice as far away from isolated trees as the trees are high.
- When you feel the electrical charge --** if your hair stands on end or your skin tingles -- lightning may be about to strike you. Drop to the ground immediately! (Weather Eye, Lightning Safety).

<ul style="list-style-type: none"> • Guided Practice 	<p>Gather students in a group on the floor in a dark classroom. “Then pop a "Wint-O- Green" or "Pep-O-Mint" lifesaver into your mouth. While keeping your mouth open, break up the lifesaver with your teeth and look for sparks. If you do it right, you should see little bluish flashes of light” (Weather Eye, Lightning Experiments). Have the students predict why they think this may have happened. Explain to the students that “when you break the candy apart, you're breaking apart sugars inside the candy. The sugars release little electrical charges into the air. These charges attract oppositely charged nitrogen in the air. When the two meet, they react in a tiny spark that you can see” (Weather Eye, Lightning Experiments).</p>
<ul style="list-style-type: none"> • Independent Practice 	<p>Now, the students get a chance to try the experiment themselves. Let the students work with a partner. Have the students take turns so that one student is eating the candy, while the other is observing the electrical sparks. Have them fill out the “Mouth Lightning” graphic organizer upon completion of eating their candies.</p>
<ul style="list-style-type: none"> • Closure 	<p>Once students have had the opportunity to complete their “Mouth Lightning” graphic organizer, have students meet back in a group on the floor. Have a group discussion about what the students have learned, while finishing the KWL chart to assess what students have learned.</p>
<p>Post-Assessment:</p>	<p>Use the KWL chart to assess what students have learned. In addition use the Science Weather Unit Progress Chart to record student progress.</p>

Because this lesson is dealing with a concept that many children have limited background knowledge about, Piaget’s Theory of Developmental Processes is less influential. Piaget’s Theory explains that children learn through stimulation of their mental processes. In addition, they are learning to use their

previous connotations about the outside world to develop new understandings. Unless students have had significant experiences with lightning in the past, most students will not have sufficient background knowledge to build upon. This is important to note because this means teachers are going to have to foster their students' background knowledge of the subject for the first time. However, by using a KWL chart, a teacher may be surprised as to how much understanding their students actually have. In regards to Gardner's multiple intelligences, several of them are included within this lesson about lightning. To begin with, reading *Flash, Crash, Rumble, and Roll* by Franklyn M. Branley and True Kelley included those students with verbal intelligence and favor learning through words. As well, the "Mouth Lightning" experiment will appeal to many of the students because there is candy involved, however, especially to the kinesthetic learners. This experiment allows for the use of tangible objects that can be touched, tasted, and observed, a variety of actions demonstrating kinesthetic movement. Unlike most of the other lessons in this unit, this lesson does not include a song for the students to learn. When including songs in a lesson, they should be educational, and there are few if any educational songs about lightning. Thus, the musical intelligence is not addressed in this lesson. Nevertheless, if an educational song about lightning were found, it would be appropriate to teach it during the anticipatory set. Lastly, since in this lesson, the students are encouraged to work in groups, it is directed to the students with interpersonal intelligence. These students like to work in groups, and enjoy collaboration one on one with partners. Furthermore, any honorable science lesson should include some aspects of the

inquiry process. The first inquiry skill posed in this lesson is that of observation. This takes place through the use of some or all of the five senses. This lesson is unique in that students get to use their sense of taste in addition to sight and touch. Because students are not asked to use their sense of taste often, they are even more likely to retain what they learn from this experiment. The next step of the inquiry process being asked to use is communication. The students are asked to communicate with a partner and share their findings. Generally, this lesson provides another example of an effective science lesson.

Lesson 10: Thunder

Title:	Thunder Cake		
Content Area: Science		Grade: 1 st	Duration: 1 hour 15 min.
Standards and Benchmarks:	<p><u>State Standards:</u></p> <p><i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations</p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 2-</i> Students write and speak for a variety of audiences and purposes.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Objectives:	<ul style="list-style-type: none">• TSW have a primary understanding of thunder and what causes it.• TSWBAT identify how the weather affects people and how they adapt to it.• TSW discuss their own fears about storms, and communicate ways they might be able to overcome these fears.		
Resources and Materials:	<ul style="list-style-type: none">• <i>Thunder Cake</i> by Patricia Polacco• Paper Plates		

	<ul style="list-style-type: none"> • Napkins • Oven • <i>Thunder Cake</i> Recipe (located in <i>Thunder Cake</i> by Patricia Polacco) • Ingredients for <i>Thunder Cake</i> • <i>Thunder Cake</i> Graphic Organizer (Appendix A) • Science Weather Unit Progress Check (Appendix A) • <i>Thundering Rainstorm</i> CD by Environmental & Ecological Sound
Differentiation:	It is possible that some students will be uncomfortable about sharing scary experiences. Thus, it is important to take this into consideration if some students do not want to share.
Preparing Students for the Lesson: <ul style="list-style-type: none"> • Transitions • Expected behaviors 	<p>Get students thinking about thunderstorms and how they affect people. Ask: What do you do during a thunderstorm? Discuss what types of fears your students have about thunderstorms.</p> <p>Some students may be shy about sharing their fears. Others may have fears about storms, but claim they do not.</p>
Teaching the Lesson (Lesson Sequence/Activities): <ul style="list-style-type: none"> • Motivation/Anticipatory Set 	<p>Begin the lesson by reading <i>Thunder Cake</i> by Patricia Polacco aloud to the class. Teach the class the song Thunder and Lightning:</p> <p style="text-align: center;">Thunder and Lightning</p> <p style="text-align: center;">(to the tune of "Pop Goes the Weasel")</p> <p style="text-align: center;">When a storm begins in the clouds, It sometimes may look frightening. You see a quick electrical spark-- Flash! goes the lightning!</p>

<ul style="list-style-type: none"> • Pre-Assessment/ Activating Background Knowledge 	<p>Long and thin and streaky and fast, Its glow is oh so brightening. Watch for the electric spark-- Flash! goes the lightning!</p> <p>When a storm begins in the clouds, It truly is a wonder. You hear a rumble loud in the sky-- Clap! goes the thunder!</p> <p>Lightning bolts are heating the air, Over clouds and under. When the air expands enough-- Clap! goes the thunder.</p> <hr/> <p>Explain to the class that you are going to talk about the different ways weather makes people feel.</p> <p>Also, explain to your students that they get to do an experiment today and they are going to get to bake their own class Thunder Cake. Let them know that just like there are special ingredients needed to make a thunderstorm, there are special ingredients required to make a good cake.</p>
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<ul style="list-style-type: none"> Teacher Input, Modeling, & Checking for Understanding Guided Practice Independent Practice Closure 	<p>After reading the story <i>Thunder Cake</i> by Patricia Polacco aloud to the class, ask: “What did Babushka do to help her granddaughter not be afraid of the storm? Did it work? What did the little girl learn about how far away the lightening is? Did the counting help her? How?” Then ask, 'Have you ever had a time when you were frightened during a storm?’ (Smell of Thunder, 1997). Now it is time to tell students that they are going to help make a Grandma Babushka’s Thunder Cake!</p> <ol style="list-style-type: none"> 1. Ask some students to place cupcake holders into trays. As you proceed in making the cupcakes, use as many student helpers as possible to measure and mix the ingredients. 2. Mix all of the ingredients while the class observes. 3. Now it is time to bake the cupcakes. They will only take about 15 minutes. After baking they will need to cool for about 10 minutes before frosting. 4. You will need an oven to bake these in, perhaps the teacher’s lounge? 5. As they bake, gather the students in a group on the floor. Have students share times when they have been scared during a storm. Play the <i>Thundering Rainstorm</i> CD by Environmental & Ecological sound while students share their feelings. 6. Ask students to share other ways to help them not be frightened during storms. <p>Have each student draw a picture and explain one way to not be frightened during a thunderstorm on their Thunder Cake graphic Organizer (Smell of Thunder, 1997).</p> <p>Let students enjoy their cupcakes.</p>
Post-Assessment:	Use the Thunder Cake graphic organizers to assess a score on the Science Weather Unit Progress Check.

Notes & Reflections:	<ul style="list-style-type: none"> • This lesson is best done right before students go to lunch or specials. That way, while the students are gone, the teacher can frost the cupcakes. Students can then enjoy when they return.
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In accordance to Piaget's Theory of Developmental Processes, students are being asked to perform at a higher level. Students in first grade are primarily in Piaget's Concrete Operational Stage and are able to think in a more logical manner. This stage lasts approximately from the ages of 7-11 (Harmon & Jones, 2005). Thus, as children get older, they begin to operate at a higher level within this stage. Because students are being asked to expand their thinking skills when prompted with the questions about ways to not get frightened, they are using higher level thinking skills. When it comes to Gardner's multiple intelligences, verbal linguistic is distinguished once again in this lesson during the read aloud of *Thunder Cake* by Patricia Polacco. Perhaps some logical mathematical learners could benefit from the measuring of the ingredients while making the cake mix. These students probably understand first hand that it is imperative to measure correctly in order to produce a good cake. In addition, students who possess spatial intelligence can also benefit from this lesson and will enjoy drawing a picture to explain how they could overcome their fear of storms. Next, kinesthetic learners have an advantage once again being able to assist in baking the cake. Still, musical intelligence learners will appreciate the *Thundering Rainstorm* CD by Environmental & Ecological Sound during the brainstorming

activity on the floor. Even though the CD is strictly musical without any words, musically intelligent learners absorb more information when there is sound in the background. Also, the “Thunder and Lightning” song reiterates information through song that was previously learned for the musically intelligent learners. Additionally, both interpersonal and intrapersonal learners will achieve maximum learning results during the group discussion on the floor and the independent Thunder Cake graphic organizer activity in the end. Perhaps the sounds of nature on the Thundering Rainstorm CD will attract the naturalist learners as well. As a final point, students are given the chance to use some of the inquiry process skills. First of all, they are asked to observe. This is referred to as the most essential of the scientific thinking processes because without this skill, no one would be able to obtain information about the outside world (Lind, 2005). This lesson is distinctive because students are using all five of their senses: (a) sight, (b) smell, (c) sound, (d) touch, and (e) taste. On the other hand, the sense of smell is used only if the students can smell the cake batter or the cake while it is baking. Subsequently, students are being asked to communicate what they have comprehended about the story, fears they have about storms, and what they may do to overcome their fears.

Lesson 11: Tornadoes

Title:	My Tornado		
Content Area: Science		Grade: 1 st	Duration: 1 hour
Standards and Benchmarks:	<p><u>State Standards:</u></p> <p><i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations</p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 2-</i> Students write and speak for a variety of audiences and purposes.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Objectives:	<ul style="list-style-type: none">• TSWBAT have a basic understanding of tornadoes and how they are formed• TSWBAT demonstrate an understanding that the United States is most known for tornadoes• TSWBAT know how to protect themselves in the event of a tornado• TSWBAT draw pictures of and write sentences about tornadoes• TSWBAT create a simulated tornado in a bottle		

Resources and Materials:	<ul style="list-style-type: none"> • <i>The Storm Book</i> by Charlotte Zolotow • several 2-liter plastic bottles • water, food coloring (optional) • duct tape • scissors • ruler • Science Weather Unit Progress Check (Appendix A). • My Tornado graphic organizer (Appendix A). • <i>Tornadoes</i> Song by Ron Brown
Differentiation:	Some students may need help constructing their Tornado in a Bottle project.
Preparing Students for the Lesson: <ul style="list-style-type: none"> • Transitions • Expected behaviors 	Most students should have some background knowledge about tornadoes. However, if they don't, this lesson should provide enough information to keep children informed about the dangers of tornadoes.
Teaching the Lesson (Lesson Sequence/ Activities): <ul style="list-style-type: none"> • Motivation/ Anticipatory Set 	<p>Read <i>The Storm Book</i> by Charlotte Zolotow aloud to the class to provide more background information about tornadoes and storms. Next, go to http://www.songsforteaching.com/intellitunes/tornadoes.htm and have the class listen to <i>Tornadoes</i> by Ron Brown.</p> <p style="text-align: center;"><u>Tornadoes Lyrics</u></p> <p style="text-align: center;">Looks like we've got us a tornado!</p>

	<p>Tornado! Big wind comin'! Tornado! Big wind comin'!</p> <p>When the thunder rolls And the big winds blow And the lightning streaks the sky, You might see a funnel cloud appear Right before your eyes.</p> <p>When warm wet air meets cool dry air, The warm air starts to spin. Twisting, turning, rising up In a big whirling wind.</p> <p>You'd better hold on tight With all your might 'Cause it's a tornado.</p> <p>You'd better get down low When a twister shows And things start flying by. It's a tornado!</p> <p>Tornado! Big wind comin'! Tornado! Big wind comin'!</p> <p>Two hundred-fifty miles per hour roaring in the sky, You might hear the sound of a fast freight train As the vortex goes by.</p> <p>Tornadoes form on land or water, That we know is true. When you see a dark and greenish sky You'll know what to do.</p> <p>You'd better hold on tight With all your might 'Cause it's a tornado.</p> <p>You'd better get down low When a twister shows And things start flying by. It's a tornado!</p> <p>Well, there goes my hairdo.</p>
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	<p>Did you just see a cow fly by?</p> <p>Tornado! Big wind comin'! Tornado! Big wind comin'! Tornado! Big wind comin'! Tornado! Big wind comin'</p>		
<ul style="list-style-type: none"> Pre-Assessment/ Activating Background Knowledge 	<ul style="list-style-type: none"> Start off a group discussion by showing the students a map of the United States. Tell them that the United States is more prone to tornadoes than any other place in the world. Ask students if they know what a tornado is. Ask them if they have ever seen a picture of one. If they have, ask them what it looked like. Fill out a KWL chart to get a feel for how much your students know about tornadoes. 		
<ul style="list-style-type: none"> Teacher Input, Modeling, & Checking for Understanding 	Know About Tornadoes?	Want to Know About Tornadoes?	Learned About Tornadoes?
<ul style="list-style-type: none"> Guided Practice 	<ul style="list-style-type: none"> Explain as simply as possible that a tornado occurs when cool, dry air from the North, mixes with warm, moist air from the South. Show the students several pictures of tornadoes, but make sure to explain that they are only scary if you don't respect them Talk with the students about what to do if a tornado is near <ul style="list-style-type: none"> If you are at home, go or stay inside. Head to the basement or to a room with no windows If you are outside and can't get indoors, lie in a ditch 		

<ul style="list-style-type: none"> • Independent Practice 	<ul style="list-style-type: none"> - If you are in school, listen to your teachers directions about what to do - Have the students practice the tornado drill for your school <ol style="list-style-type: none"> 1) Have the students create a simulated tornado in a bottle (use www.exploratorium.edu/snacks/vortex.html for a reference on how to make one) 2) Once they have finished, ask them to draw a picture of their “homemade” tornado on the My Tornado graphic Organizer (Appendix A). 3) Underneath their picture, have the students write a short paragraph, no more than five sentences about what they have learned about tornadoes. 4) Do they think their tornado looks like the pictures they have seen?
<ul style="list-style-type: none"> • Closure 	<ol style="list-style-type: none"> 1) Get the students together in a group to discuss what they have learned about tornadoes 2) Ask them what tornadoes look like 3) Ask the students what they would do if a tornado was coming
Post-Assessment:	Complete the KWL chart once returning to a group on the floor. Look over each student’s My Tornado graphic organizer to assess a score on the Science Weather Unit Progress Check.
Notes & Reflections:	It is best to model how to assemble the tornado in a bottle activity before sending the students off to make their own.

To begin with, there is no doubt that Piaget’s Theory of Developmental Processes is coming into play during this lesson. Without doubt, the children’s mental processes are being stimulated. Or, the students are using previous

knowledge to expand their current awareness about the world. Besides Piaget's Theory of Developmental Processes, several of Gardner's multiple intelligences are brought about in this lesson. The first intelligence brought about, verbal intelligence, occurs when *The Storm Book* by Charlotte Zolotow is read aloud to the class. After that, students are proposed to draw a picture of what their tornado looked like, which attends to the students who prefer spatial intelligence learning. In other words, these types of students have the preference of working with colors and pictures while they learn (Lewis, 2004). Along with the previous intelligences, Gardner's fourth intelligence, Kinesthetic is also included. During this lesson, students are prompted to construct their own tornado in a bottle. For kinesthetic learners, there is no better way to create an understanding of how tornadoes are formed. Next on Gardner's list of intelligences is musical. This lesson also addresses those with musical intelligence when referring to the song *Tornadoes* by Ron Brown. Some students will hear this song and the lyrics will be absorbed into their brains forever. Then, both those with interpersonal and intrapersonal intelligence are given the opportunity to shine in their element. During group discussions, students with interpersonal intelligence will thrive when it comes to participation. Yet, intrapersonal learners will also be given the chance to work independently when it comes time to construct their own tornado in a bottle. In the end, there are still elements of scientific inquiry, making this lesson exemplary. To start with, an engaging anticipatory set will set students up for successful completion of the assignment. In this way, it has been suggested that when students' curiosity is peaked, they are more likely to use all of their

senses to learn (Lind, 2005). If students are interested in the topic at hand, they are more likely to retain that information and have a greater chance of utilizing the inquiry process skills to the fullest. In this lesson, students are first asked to listen to and observe certain aspects about tornadoes. The most powerful inquiry process, observation is crucial when it comes to learning. Preceding observation, students are asked to communicate in writing how they would protect themselves in the case of a tornado, another key component of the inquiry process.

Lesson 12: Rainbows

Title:	ROY-G-BIV		
Content Area: Science		Grade: 1 st	Duration: 1 hour
Standards and Benchmarks:	<p><u>State Standards:</u></p> <p><i>Science Standard 1-</i> Students apply the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations</p> <p><i>Science Standard 4-</i> Students know and understand the processes and interactions of Earth’s systems and the structure and dynamics of Earth and other objects in space.</p> <p><i>Science Standard 5-</i> Students understand that the nature of science involves a particular way of building knowledge and making meaning of the natural world.</p> <p><i>Reading and Writing Standard 2-</i> Students write and speak for a variety of audiences and purposes.</p> <p><i>Reading and Writing Standard 3-</i> Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.</p> <p><i>Reading and Writing Standard 4-</i> Students apply thinking skills to their reading, writing, speaking, listening, and viewing.</p>		
Objectives:	<ul style="list-style-type: none">• TSWBAT identify the colors of a rainbow using ROY-G-BIV• TSW get to create their own rainbows• TSW have a basic understanding of how rainbows are formed		
Resources and Materials:	<ul style="list-style-type: none">• Glass of water• Piece of white paper• The sun		

	<ul style="list-style-type: none"> • <i>All the Colors of the Rainbow</i> by Allan Fowler • Making a Rainbow graphic organizer (Appendix A). • Science Weather Unit Progress Check (Appendix A).
Differentiation:	Some students may have never seen a rainbow in real life and won't realize that it is an actual occurrence. Therefore, it is essential to show multiple photographs of real rainbows.
Preparing Students for the Lesson: <ul style="list-style-type: none"> • Transitions • Expected behaviors 	<p>Explain to students that a long time ago "people believed that rainbows were magic. Some believed that if you find the end of the rainbow where it touches the earth you will find a pot of gold. Clarify that a rainbow is caused by sunlight shining on raindrops. To see a rainbow, you must have the sun behind you and rain falling in front of you. Sunlight looks white, but it is really made up of many colors. When sunlight enters a raindrop, it divides into various color spectrums. The rainbow reflects these colors, like a mirror. Many rays of sunlight, breaking up into their colors and reflecting off many drops of falling rain, make a shimmering, curved, colored rainbow" (Wilson, 1996).</p>
Teaching the Lesson (Lesson Sequence/ Activities): <ul style="list-style-type: none"> • Motivation/ Anticipatory Set 	<p>Read aloud <i>All the Colors of the Rainbow</i> by Allan Fowley to the class. Discuss what you have learned with the class. Next, teach the students the following song, Rainbow:</p> <p style="text-align: center;"><u>Rainbow Song</u> (Twinkle, Twinkle Little Star) When the rain falls from the sky, (flutter fingers downward) Don't forget to look up high, (Cup hand above eyes and look up) If the sun is shining there, (Make a circle with arms above head) You may find a rainbow fair, (Sweep arms in an arc above head) Red, orange, yellow, green and blue, And you'll see there's purple too (Claybrook, 2003).</p>

<ul style="list-style-type: none">Pre-Assessment/ Activating Background Knowledge	<p>Teach students the colors of a rainbow by having them memorize ROY G. BIV. Tell students that as long as they are able to remember this name (you could tell them it is a leprechaun’s name), they will never forget the colors of a rainbow.</p> <p>R - Red</p> <p>O- Orange</p> <p>Y – Yellow</p> <p>G – Green</p> <p>B – Blue</p> <p>I – Indigo</p> <p>V – Violet</p>						
<ul style="list-style-type: none">Teacher Input, Modeling, & Checking for Understanding	<p>Use a KWL chart to determine what the students know, want to know, and have learned about rainbows:</p>						
<ul style="list-style-type: none">Guided Practice	<table><tr><td>Know about rainbows?</td><td>Want to know about rainbows?</td><td>Have learned about rainbows?</td></tr><tr><td></td><td></td><td></td></tr></table> <p>Have students watch while you do the following:</p> <ol style="list-style-type: none">Fill the glass all the way to the top with water.Put the glass of water on a table so that it is half on the	Know about rainbows?	Want to know about rainbows?	Have learned about rainbows?			
Know about rainbows?	Want to know about rainbows?	Have learned about rainbows?					

	<p>table and half off of the table. Be careful that the glass doesn't fall.</p> <ol style="list-style-type: none"> 3. Then, make sure that the sun can shine through the glass of water. 4. After you do that, place the white sheet of paper on the floor. 5. Adjust the piece of white paper and the glass of water until a rainbow forms (Weather Wiz Kids).
<ul style="list-style-type: none"> • Independent Practice 	Have students record what they saw on their Making a Rainbow graphic Organizer (Appendix A).
<ul style="list-style-type: none"> • Closure 	Return to a group on the floor. Have students share their findings with the class.
Post-Assessment:	Use the Making a Rainbow graphic organizer to allocate scores on the Science Weather Unit Progress Check.
Notes & Reflections:	This lesson will need to be performed on a sunny day, possibly even outside.

In the last lesson of this weather unit on rainbows, it would be inappropriate not to include any aspects of Piaget's Theory of Development. Using previous background knowledge, students are being asked to think logically as to how the rainbow was created. With the teacher's help, first grade students should have a fundamental understanding of how rainbows are made.

When it comes to Gardner's multiple intelligences, it is necessary to include as many as possible in a lesson, and all of them within a unit. This lesson begins with a read aloud of *All the Colors of the Rainbow* by Allan Fowley. In this book, a rainbow is formed after a rainstorm. In the end, there is an excerpt on how the reader can create a rainbow in their own backyard. Books of any kind appeal to those with verbal linguistic intelligence because they prefer to learn through words. Then, the Making a Rainbow graphic organizer applies to both those with spatial and kinesthetic intelligence. This is due to the fact that students are able to color and use materials (paper and pencil) in order to construct a meaningful understanding of what was being taught. Also, those who would rather learn through beats, melodies, and rhythms can gain an understanding from the Rainbow Song by Vicki Claybrook. These types of learners are said to be musically intelligent. The few remaining intelligences, interpersonal and intrapersonal are both pinpointed within this lesson. Students who acquire interpersonal intelligence like to work in groups and will enjoy the group rainbow experiment. Nonetheless, students with intrapersonal intelligence will take pleasure by working independently on their Making a Rainbow graphic organizer. Furthermore, quite a few of the inquiry process skills are brought into play to further develop students' scientific literacy. The first and most importantly recognized scientific inquiry skill, observation, is being requested during the group rainbow experiment. Next, crucial to scientific work, is communication (Abruscato, 2004). During this lesson, students are being asked to explain and predict how the teacher created the rainbow. Not only is communication a skill

needed for scientific literacy, but students need to be able to predict and hypothesize based on what they know. Therefore, the last skill, prediction, has also become a part of this lesson.

Summary

In completion, this unit is an exemplar prototype of what a successful science unit looks like. Included throughout the lessons are the most important aspects required to promote scientific literacy for students. To begin with, this unit addresses various theories in science education that drive how science can best be elicited. Piaget's Theory of Development details the physical capabilities of students at varying levels of development. Thus, if one is aware of these abilities, they can more easily address what needs to be done to stretch these skills to their maximum potential. Piaget's theory focuses on the notion that (a) children are motivated to learn, (b) develop knowledge through repeated experiences, (c) learn through assimilation and accommodation, (d) interact with social and physical environments in order for cognitive development to occur, and (e) must be in a state of equilibrium before they move into a new state of understanding. All of these lessons encourage growth according to these ideas in a positive direction. In addition, Gardner's theory of multiple intelligences concentrates on the belief that every child has a unique learning style (Lind, 2005). Identifying eight intelligences, it is vital for each one to be used within every unit of study to provide the ultimate learning environment. Yet this is another reason why this weather unit of study is a good model. While each lesson does not contain all of Gardner's eight intelligences, each intelligence is

addressed upon within the unit as a whole. Lastly, it is clear why incorporating the scientific inquiry process skills is vital to scientific literacy. These skills: (a) observe, (b) compare, (c) classify, (d) measure, (e) communicate, (f) predict, (g) infer, and (h) hypothesize comprise the necessities for learning science effectively. Moreover, at some point all of these inquiry process skills are integrated within this unit. Clearly, it is apparent that this science weather unit consists of all the essential building blocks when it comes to acquiring scientific literacy in the elementary classroom.

Chapter 5

Contribution of the Project

This research project is compiled of several components, linked together to create a resource for teachers to use as a reference. In this project, many scientific notions were pulled from chapters 1-3 to construct a meaningful and accomplished science unit to exemplify the best practices for teaching science in the elementary classroom. Because science is a part of everyday life, it is fundamental that students today obtain sufficient background knowledge in science. However, the funding for science in public schools across the U.S. is steadily decreasing, creating concern for the future of our scientific community. Besides these issues, many teachers do not feel comfortable teaching science, thus it is not being taught efficiently. Therefore, resources need to be available to offer teachers appropriate ways to demonstrate how to teach science successfully. For these reasons, a science unit on weather was implemented to provide and demonstrate how these effective scientific practices could be put into place. Lastly, various educational professionals were asked to look over this project and evaluate limitations of the project, suggestions for further research and study, and strengths of the project. All of the feedback collected has been integrated to form this final chapter, which will attend to common concerns and questions in regards to this project.

Resolution of the Original Problem

The purpose of this project was to develop a science unit on Weather to demonstrate an example of effective instruction to teachers. In addition, it was an objective that teachers would have a concrete reference, allowing them to see the elements of effective teaching incorporated into an interactive series of lessons, which they would be able to apply to their own classrooms. While this project did not resolve all elements of the original problem in the scientific community that sparked this project, the project itself provided all the implied aspects it intended. Not only does each lesson itself demonstrate elements of how to teach science effectively, but each lesson is completed with a thorough explanation of how it applies to the theories presented in Chapters 1-3. Overall, it is anticipated that this project will serve as a stepping stone for teachers who feel distressed or uninformed when it comes to teaching science.

Limitations to the Project

One of the main limitations identified in this project by evaluators was the issue of time. It was felt that while each lesson was allotted enough time for completion, the reality of teaching does not always allow for this much time to be utilized. To begin with, most schools across the U.S. are limited to how much time they can spend on each subject. This usually ranges anywhere from thirty minutes to one hour. It is quite rare that more than one hour of science time is included in a daily elementary school schedule. Also, the length of the unit was a concern. Some of the evaluators felt as though it might be hard to include a science unit that stemmed for more than seven or eight lessons. On the upside,

the evaluators felt as though it was better to have too much to do, than not enough. Thus, one evaluator mentioned that in order to fit in each lesson, some of the elements in each lesson or some entire lessons in the unit may need to be taken out if necessary. Moreover, while this project contained many characteristics that demonstrated what a quality science lesson includes, there are some great recommendations for further research and study. To begin with, it was suggested that more age and grade appropriate literature be included within the science unit. It was explained that while there are many great read aloud books that appear in these lessons, this would give students an opportunity to read independently or with a partner. Furthermore, it was recommended that more technology be integrated into the Science Weather Unit. There are many websites out there that offer pictures of various types of weather, such as flicker.com that may be used to present a slideshow to the students. Similarly, it was suggested that the students could even make their own slideshow upon completion of the unit to demonstrate what they had learned. Moreover, some schools have technology teachers that would be a great resource to utilize for this domain. Lastly, it was proposed that there are many great websites for kids that deal with weather. These websites could be made us of during centers time or for extracurricular activities. In general, introducing age appropriate literature for students to read independently and technology into the lessons would further enhance this unit of study.

Recommendations for Further Research and Study

In addition to the evaluations of the limitations to the project, some recommendations for further research and study were also received. One evaluator suggested that a teacher could use an aviation theme to teach a science unit. It was in her opinion that many students are fascinated with this topic, and that many scientific and mathematical lessons could be developed around this subject. There are many local flying organizations that have material appropriate for younger students, whose members would be delighted to share their field of work. Even though the science theme would be different, researchers could use the scientific elements presented in Chapters 1 - 3 to come up with an effective science unit for an elementary classroom. Besides the topic of aviation, there are several other scientific themes that could be pursued, while still keeping the essentials in mind that are necessary for constructing a successful unit. Further research and study may also be geared towards a different age group or grade. Although this capstone focuses on science in elementary schools, and a project with an emphasis on the first grade, scientific literacy is important for all grade levels. Decreasing scientific literacy and ineffective science teaching is also apparent in middle and high school. Thus, this capstone could be adapted and modified to fit the needs of secondary students. Perhaps some of the information in Chapters 1 - 5 could be researched further, and the project could be changed to assist teachers who teach in the upper grade levels.

Assessment and Feedback

This project received lots of positive feedback from the professionals who evaluated it. To begin with, the variety of the materials presented throughout this unit was brought up. These included multiple teaching strategies, scientific subject matter, ideas for differentiation, Bloom's higher and lower level thinking strategies, questioning techniques, and fun and motivational activities. In regards to differentiation, it was stated that this project showed a conscientious effort to reach all students. This was done by using a variety of motivational techniques that appealed to linguistic, logical, spatial, musical, kinesthetic, interpersonal, intrapersonal, and/or naturalist learners. Also, ESL students were acknowledged in many of the lessons as well. Moreover, several teaching strategies were built-in to the lessons such as: (a) identifying similarities and differences, (b) reinforcing effort, (c) practicing, (d) nonlinguistic representations (graph organizers, KWL charts), (e) cooperative learning, (f) generating/testing hypotheses, and (f) questioning. It was also pointed out that each lesson built upon the others in regards to higher level thinking skills. Those included were: (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis and (f) evaluation. All of these skills are part of the inquiry process and aid in the development of scientific literacy. To sum up, all of the professional evaluators felt as though this project was well thought out and put together. Consensus stated that all lessons were age appropriate, while still adhering to the Colorado State Content Standards. This project could be implemented with minimal changes to meet the needs of almost any first grade classroom. Evaluators felt as

though all of the hands on activities within the lessons were engaging and would keep the attention of all the students. Plus, it was agreed that all of the lessons in this Science Weather Unit would be easily adaptable for struggling students or even the students who are above grade level. As a final point, all the professionals who evaluated this project appreciated the songs in almost all of the lessons, and thought they offered a unique touch to the unit.

Summary

By and large, this project turned out to be a success. While there were still some limitations and suggestions for further research and study, as is to be expected, the overall feedback received was positive. Additionally, the purpose of this project was fulfilled and while all of the problems encompassing the scientific community were not solved, the concern for teachers on how to teach science effectively was. This Science Weather Unit is a reliable resource, consisting of multiple avenues that address how to implement effective science teaching in elementary classrooms today.

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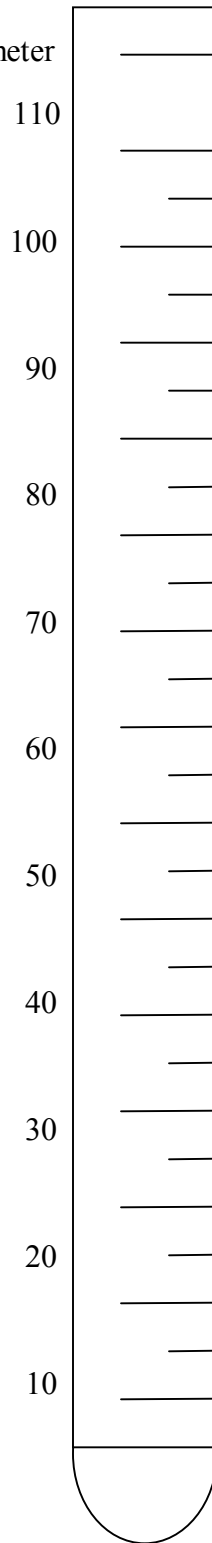
APPENDIX A

Graphic Organizers for Science Weather Unit

Name _____

COLD WATER

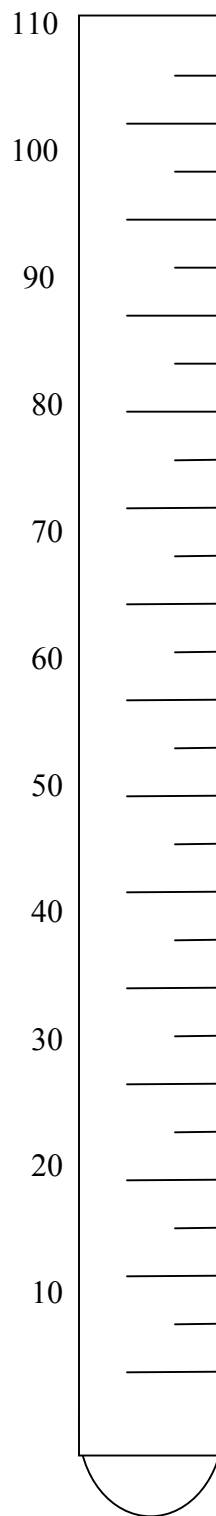
Color in what your thermometer
looks like when you put
it in the cold water



Name _____

WARM WATER

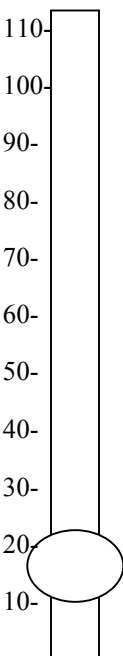
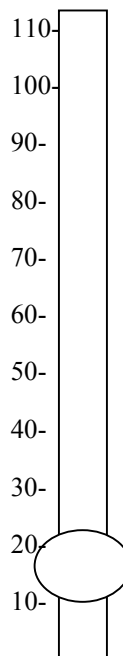
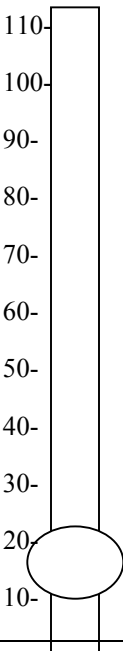
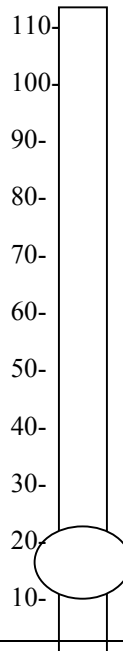
Color in what your
thermometer
looks like when you
put it in
the warm water.



Name _____

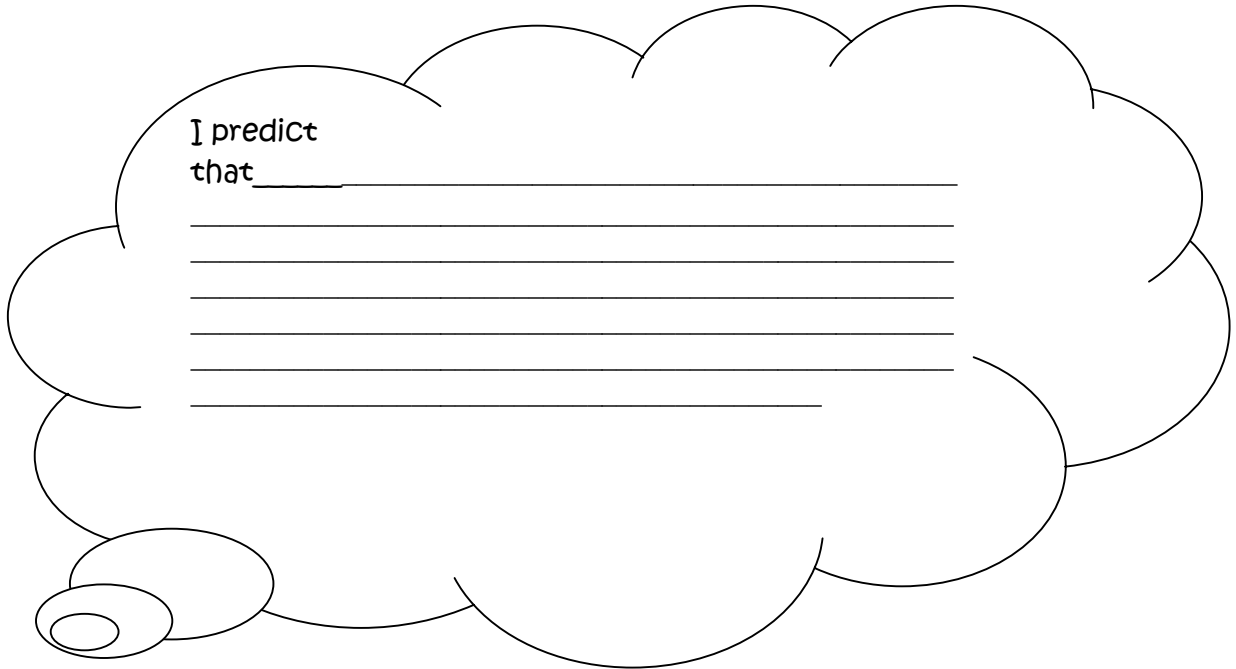
TEMPERATURES IN MY SCHOOL!

Use the thermometer to check the temperature of four different locations or objects around our school. In each box, draw the place or thing where you put the thermometer and record the temperature on the thermometer.

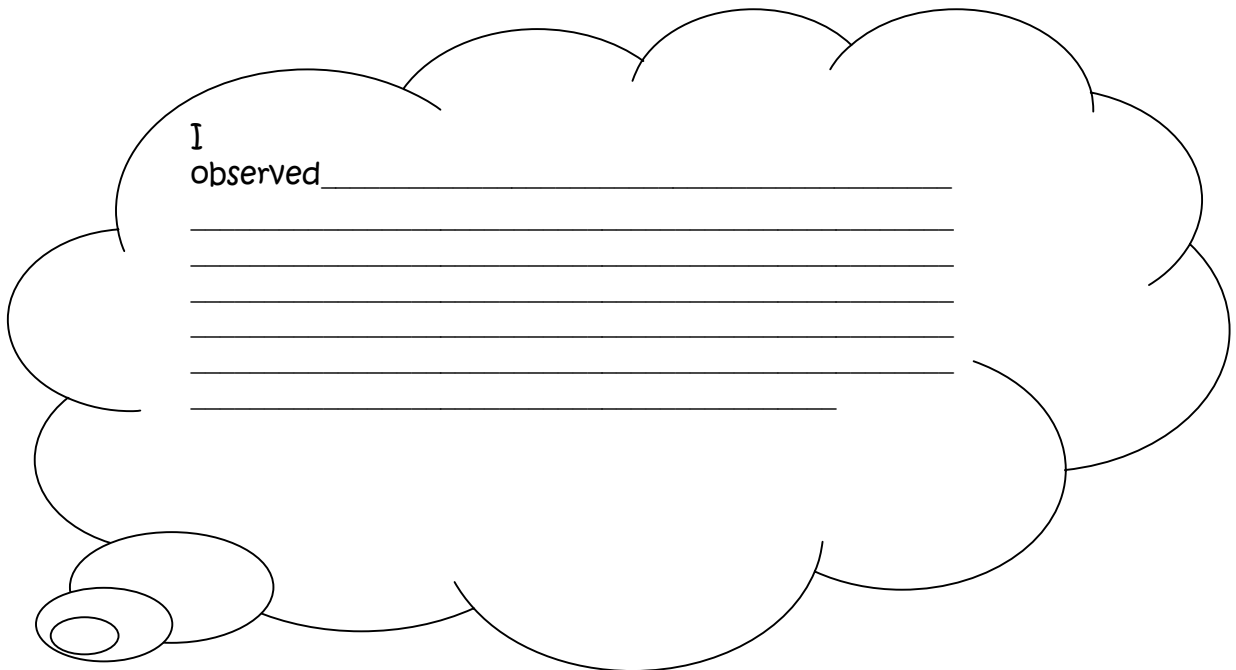
 <p>110- 100- 90- 80- 70- 60- 50- 40- 30- 20- 10-</p> <p>PRINCIPALS OFFICE</p> <p>It was _____ degrees</p>	 <p>110- 100- 90- 80- 70- 60- 50- 40- 30- 20- 10-</p> <p>SCHOOL FREEZER</p> <p>It was _____ degrees</p>
 <p>110- 100- 90- 80- 70- 60- 50- 40- 30- 20- 10-</p> <p>LIBRARY</p> <p>It was _____ degrees</p>	 <p>110- 100- 90- 80- 70- 60- 50- 40- 30- 20- 10-</p> <p>PLAYGROUND</p> <p>It was _____ degrees</p>

NAME _____

April Showers



I predict
that _____



I
observed _____

Name _____

Warmth Chart

In the Classroom

COLD	COOL	WARM	HOT
-------------	-------------	-------------	------------

In the Shade

COLD	COOL	WARM	HOT
-------------	-------------	-------------	------------

In the Sun

COLD	COOL	WARM	HOT
-------------	-------------	-------------	------------

What Did You Discover?

Name _____

Leaf Comparison: Shape



Leaf Comparison: Size



Leaf Comparison: Color



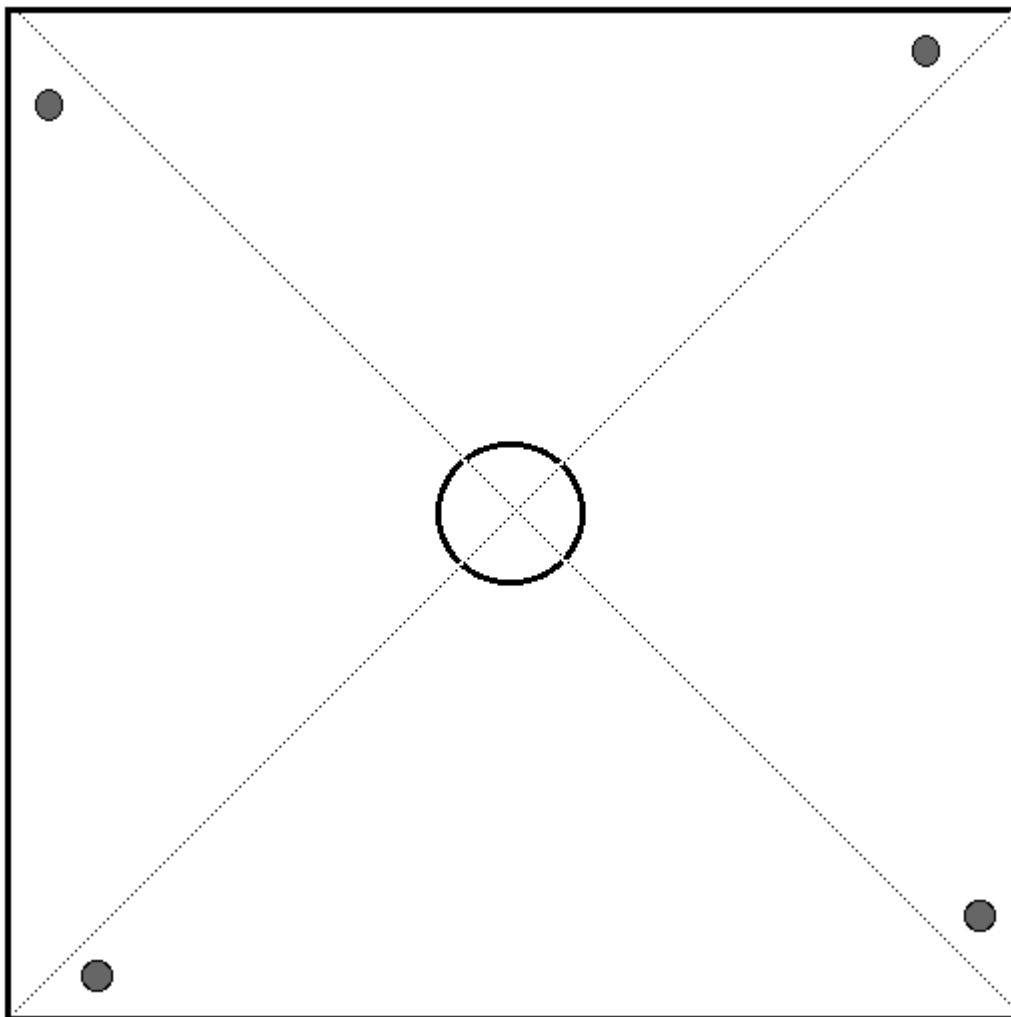
Name_____

THE TRAVELING PINWHEEL

Does your pinwheel move when it is in the following situations? State yes or no, draw a picture of the scenario and finally write 1-2 sentences about your discoveries.

WHEN BLOWING ON IT	OUTSIDE
BY A HEATVENT OR AIRCONDITIONER	YOUR CHOICE

Pinwheel Template



Name _____

Mouth Lightning

Draw a picture of what you saw inside your partner's mouth. Then, describe what you observed.



A large rectangular box with a black border, intended for a drawing and a description. The box is mostly empty, with four horizontal lines near the bottom for writing.

Name_____

Thunder Cake

How might you calm your fears during a
th de to ?

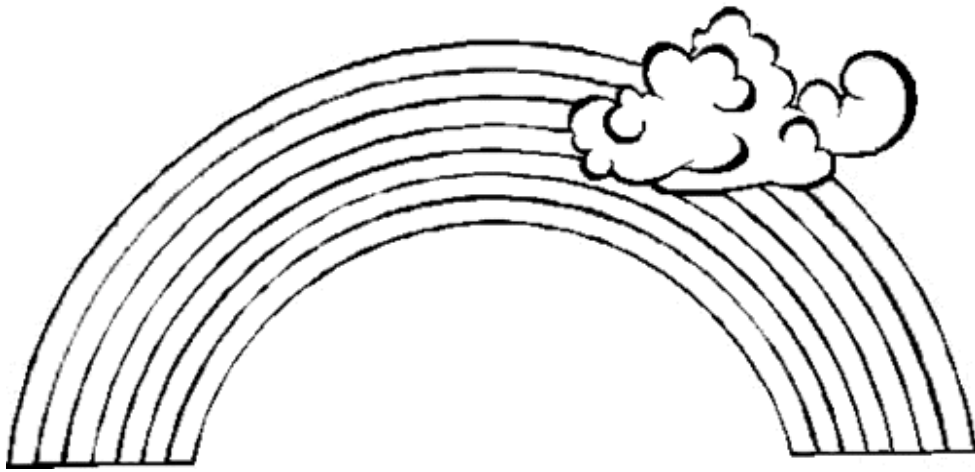
Name _____

My Tornado!

Draw a picture of what your tornado looked like. Write a few sentences about what you would do if you saw a tornado heading your way.

Name _____

Making a Rainbow



R O Y G B I V

Color in the rainbow using the ROY-G-BIV rule. Write what you observed when making a rainbow.

Science Weather Unit

PROGRESS CHECK

Student Names	<u>Lesson 1:</u> What is Temperature	<u>Lesson 2:</u> The Seasons of the Year	<u>Lesson 3:</u> Winter and Snow	<u>Lesson 4:</u> April Showers	<u>Lesson 5:</u> Sun Savvy

Student Names	<u>Lesson</u> <u>11:</u> My Tornado	<u>Lesson</u> <u>12:</u> ROY- G-BIV

Check +	The student exceeds the objectives. They demonstrate an advanced understanding of what was being taught using thoughtful explanations and consistent accuracy on their activities.
+	The student meets the objectives. They demonstrate a general understanding of what was being taught using explanations and often accurate data when referring to the activities.
Check –	The student falls slight short of the objectives. They lack a general understanding of what was being taught using mostly false explanations and inaccurate data when referring to the activities.
-	The student does not meet any of the objectives. They have no understanding of what was being taught and have consistently false explanations and inaccurate data when referring to the activities.

